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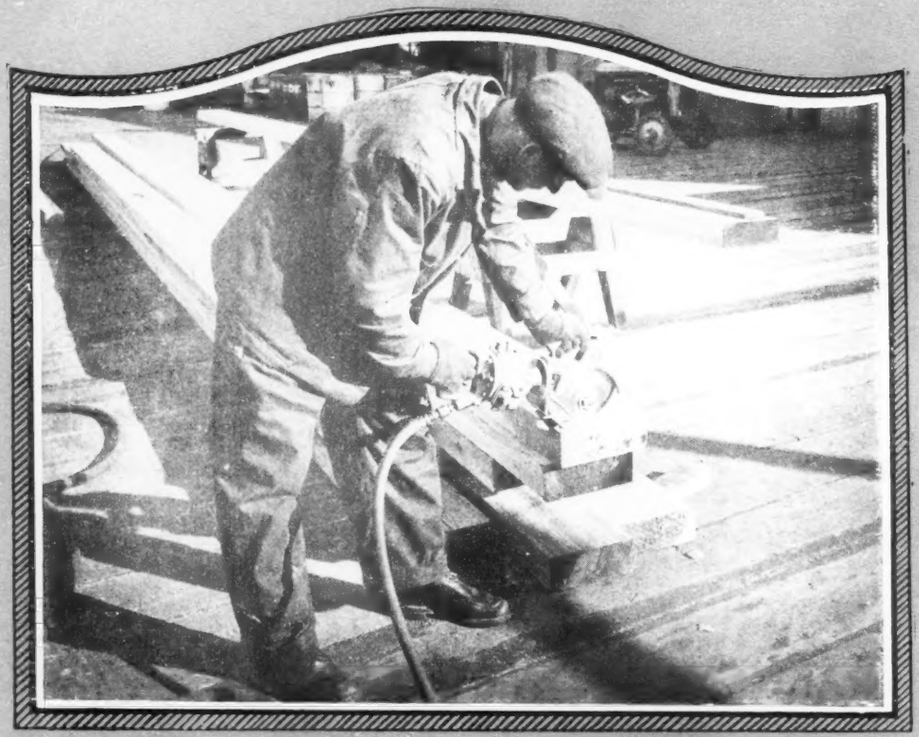

PORTABLE AIR-DRIVEN SAFETY HAND SAW THAT IS CAPABLE OF DOING USEFUL WORK IN MANY FIELDS OF SERVICE

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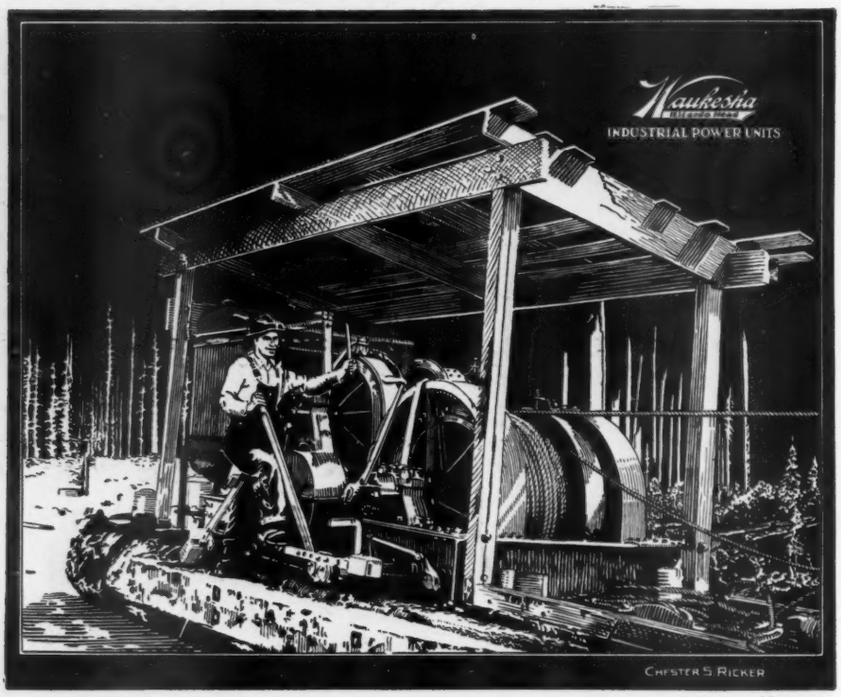
100 *H. P. Waukesha Equipped Clyde Hoist at Cazedero, Ore.*



N-712-LC

Flexible as Steam

This is one of the compliments Waukesha equipped hoists get from every operator who has used them. They are light in weight for their power, thus making it possible to skid them about under their own power. Here is one shown chunking out a new road with a drag line outfit.

They go where no steam rig could go because they use little water and an easily portable fuel, gasoline. The engines will operate at angles up to 60 degress due to special provision made for this service. They are made in complete Industrial Power Units varying in power from 20 to 125. Write for the latest bulletins No's. 540 and 581.

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Exclusive Builders of Heavy Duty Gasoline Engines for Over Twenty Years

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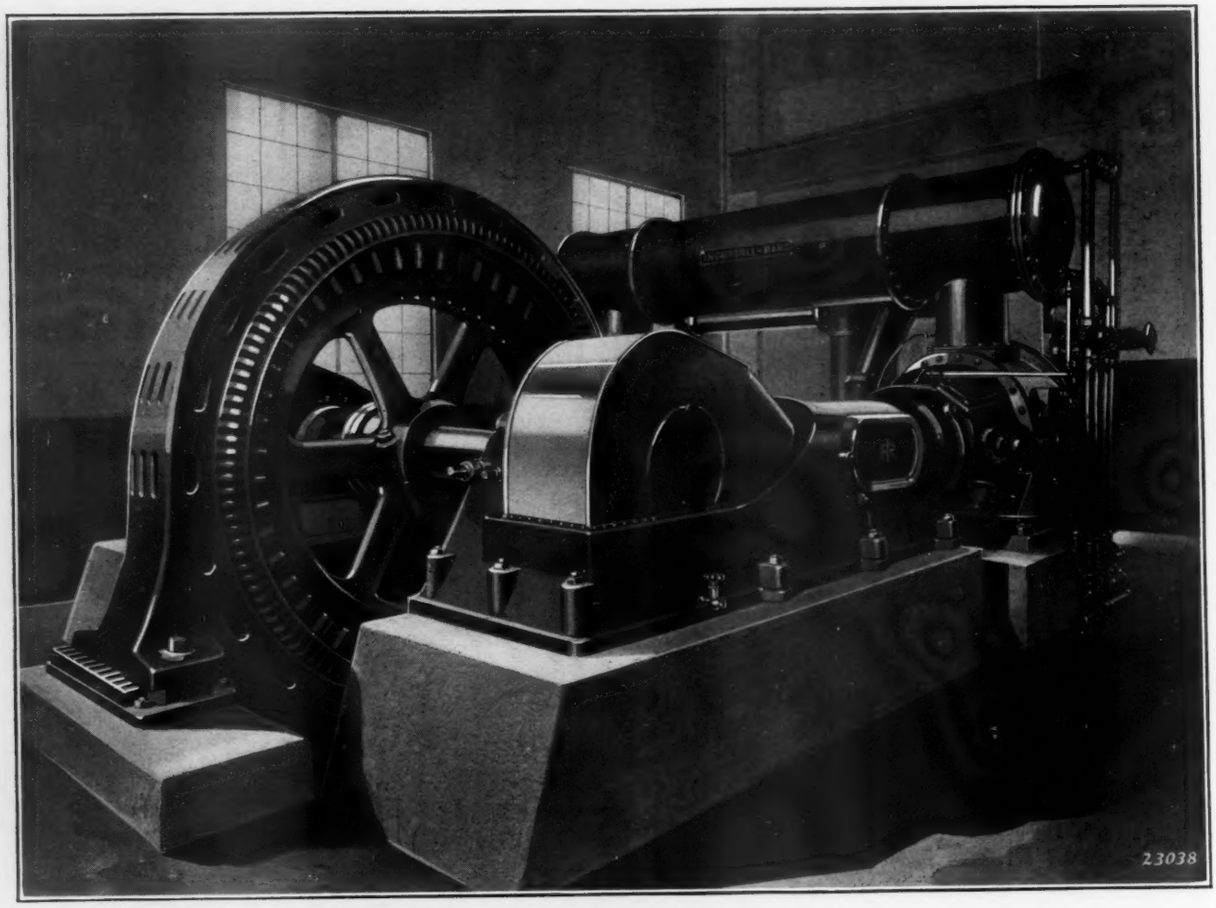


The Type PRE Ingersoll-Rand Air Compressor. The unit shown above is a 21″-stroke machine and is installed in one of the large "steel car" railroad shops. This shop has had an ever-increasing demand for Compressed Air as its work has changed from the building and maintenance of the old wooden cars and small "locos" to that of the large locomotives and steel cars.

VOL. XXXII, NO. IV

APRIL, 1927

Progressive Ice Plant Adds to Capacity

Central Ice and Cold Storage Corporation of Vineland Has Made a Fine Record

By EDGAR W. DAVIES*

PLANTS in the United States engaged in the manufacture of ice turned out in 1925, according to the latest figures available, products having a total value of substantially $187,000,000. There are more than 3,000 establishments in this department of industry that contributes in many ways to the comfort, the convenience, and the well-being of many millions of the populace.

As a matter of fact, manufactured ice has very largely supplanted ice of Nature's making even where the winter is long enough and cold enough to provide an abundance of ice on rivers, ponds, and streams. Not only that, but ice-making machinery enables people to have ice in plenty where climatic conditions render the natural formation of ice either uncertain or impossible.

There are numerous communities today that are expanding industrially at a rapid rate largely because they have local means of producing all the ice needed. This is conspicuously the case in parts of the country where agriculture has long been the predominating line of endeavor. Therefore, what has happened in the last few years in Vineland, N. J., is fairly typical of what is taking place elsewhere or what may happen elsewhere if plants for the manufacture of ice are called into being when economic conditions warrant. Vineland, a community of 22,000, is located in Southern New Jersey where nearness to the tempering influence of Delaware Bay and the Atlantic Ocean brings an early spring and delays the coming of the first of the hurtful frosts—in short, Vineland and its agricultural environs enjoy a long growing season. In addition to these climatic advantages, Vineland is within relatively easy reach of three of the country's largest markets for farm produce. These are New York City, Philadelphia, and Atlantic City with its great number of summer visitors.

MANY ice-plant managers, after ripe experience, are satisfied that there are sound operating reasons for making their plants self-contained as far as possible in the matter of primary power. The Central Ice & Cold Storage Corporation, of Vineland, N. J., reflects this attitude.

Ever since it started up in 1923, this progressive concern has relied upon oil-engine units to drive its ammonia compressors and to furnish the electric energy used in various ways in the manufacture and the handling of the ice produced there.

By way of substantiation of the correctness of this choice of prime mover, the Vineland company has recently amplified its refrigerating equipment by adding another oil-engine ammonia-compressor unit. The reasons for this action will probably prove of interest to other managers engaged in the same department of industry.

Besides its agricultural interests, Vineland boasts factories that are engaged in the production of glass, chemicals, artificial stone, clothing, shoes, etc. Some of these industries are the outcome of the healthful conditions that prevail, and also because the neighborhood has drawn to it numerous willing and capable workers. In fact, Vineland is a bustling place having much about it to appeal to the businessman and to the home seeker. Vineland as a center exerts its influence upon an area having a radius of 25 miles. Now, let us see what manufactured ice is doing directly and reflexively for this attractive and thriving place.

Prior to 1923, the people of the City of Vineland and those of its immediate environs obtained most of their ice from outside sources. Recognizing the handicaps and the inconveniences that this imposed, the Central Ice & Cold Storage Corporation was organized, and an up-to-date ice-making plant was started in 1922. In April of the following year the plant was ready to begin operations. The importance of its activities has been accentuated by the services rendered during each succeeding year; and, as a consequence, the management has amplified the plant's field of usefulness as well as the plant's capacity to meet growing demands.

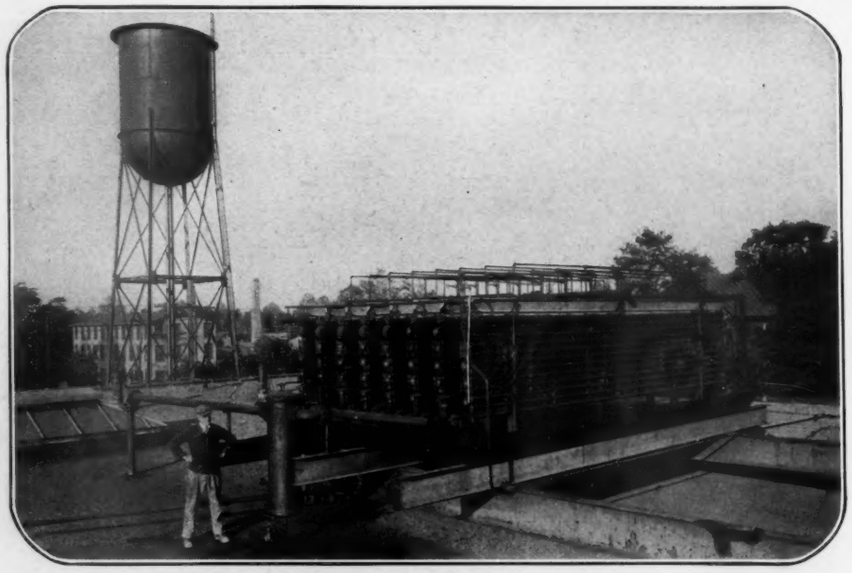
The initial capacity of the plant was 50 tons of ice every 24 hours, and during the first year of its service it produced only ice. However, it was soon made apparent that the Corporation would be justified in building an annex, one story high, that could be devoted to cold storage—the foundation being made strong enough to carry five stories if business ultimately warranted the expansion.

This Magazine, in its issue of November, 1923, published a comprehensive description of the plant of the Central Ice & Cold Storage Corporation; and it might be mentioned briefly now that the corporation decided at the outset that the plant should be as nearly as possible a self-contained one—that is, provided with its own water supply and source of primary power. To that end the plant was equipped with a 100-H.P. Ingersoll-Rand oil engine, directly connected to a 65-Kw. dynamo

*Manager, Central Ice & Cold Storage Corporation.

—the electric current being used to light the plant and to provide power for handling the ice, for driving the brine agitators, for operating a number of centrifugal pumps, and for actuating the ER-1 compressor normally relied upon to furnish air for various purposes.

The main refrigerating units were two Type POC-1-A, horizontal, direct-connected machines, each of 100 H.P., with a rated refrigerating capacity of 51 tons, and capable of making about 30 tons of ice every 24 hours—the oil engine forming the power end of each ammonia compressor being similar to the PO engine driving the 65-Kw. generator.



Ammonia condenser mounted on the roof of the plant of the Central Ice & Cold Storage Corporation. Water tank at left is supplied by wells from which water is raised by air lift.

During the season of 1924, when the two POC-1-A machines were called upon to meet the dual demands of the ice tank and the cold-storage department of the plant, it became apparent that the equipment was working at a disadvantage from an operating and economic standpoint. This will be understandable to anyone familiar with the subject when it is mentioned that the systems of the two departments necessarily work at different back pressures. Even so, the plant has met the seasonal daily demand for 50 tons of ice, and has taken care of cold-storage space the while having a total capacity of 150,000 cubic feet. In other words, the cold-storage space at present available is able to accommodate quite 40,000 bushels of perishable foodstuffs. Before the creating of these facilities, Vineland had no cold-storage plant to take care of farm produce at periods of overabundance so that goods could be held for favorable markets.

The commodities carried vary, of course, from time to time. They consist of fruits—such as cherries, strawberries, blackberries, raspberries, peaches, pears, plums, apples, and grapes, and of other farm produce such as corn, cauliflower, cabbage, onions, and lettuce, not to mention seed potatoes.

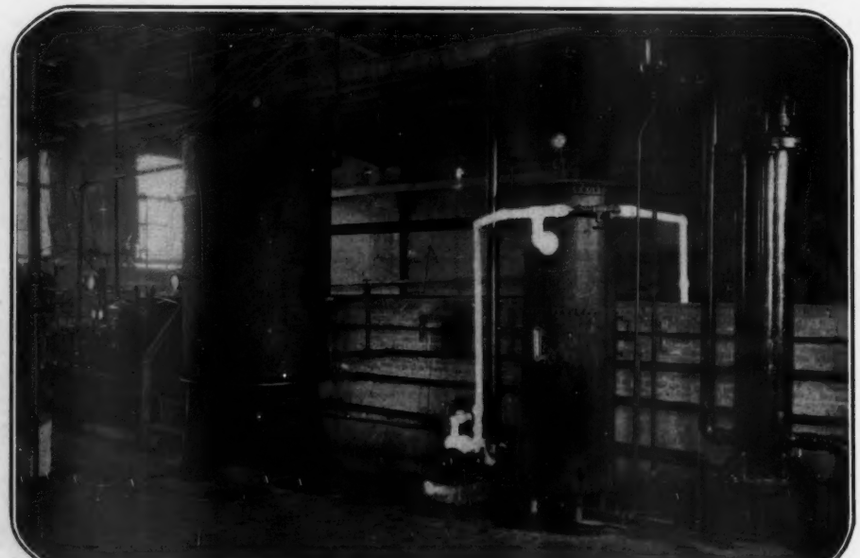
During the summer of 1926 varieties of peaches that ordinarily would have ripened in succession actually ripened at the same time; and to realize on the crop the producers placed their surplus in cold storage and marketed the peaches gradually as a demand developed. Some of the peaches were still in cold storage at the end of last October. Substantially 75 per cent. of the peach growers in the neighboring sections of the country would have lost half their crop had cold-storage space not been available to them in Vineland.

What happened in the case of the peaches happened on numerous occasions when there was a momentary glut of other perishable farm products; and, as a consequence, the agricultural fraternity was alive to what the Central Ice & Cold Storage Corporation was doing for them. Probably the best evidence of this appreciation was the voluntary action of some of these alert farmers that came to us last fall and asked: "Are you going to build bigger? If so, we have money that we can let you have if you need it."

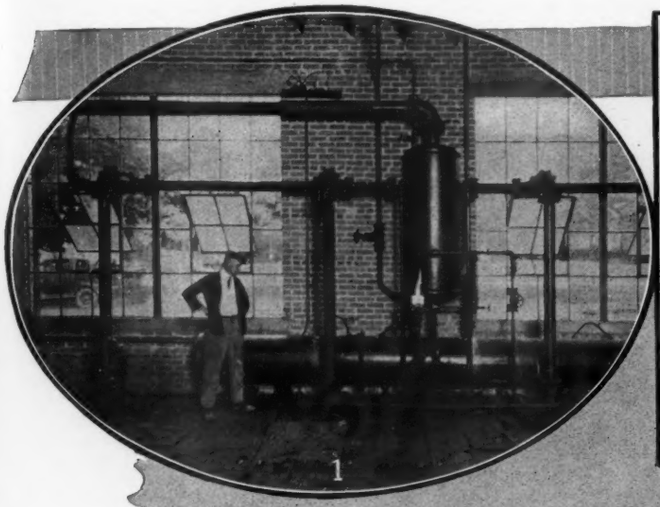
The corporation has been using its cold-storage space to capacity save for the period between March and July, when it is customary to use some of the available space for a reserve supply of stored ice. The space regularly devoted to ice storage can accommodate 100 tons. Sixty per cent. of the ice produced is sold locally by distributing dealers, and the remainder is sent to the seashore—that is, to Cape May, Ocean City, and Atlantic City.

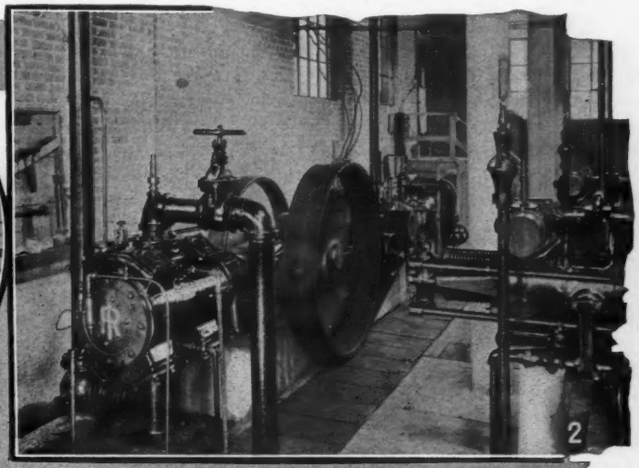
The first of every year is always an anxious one for the manager of an ice and cold-storage plant, because he naturally wonders how much it cost to make ice during the year gone and likewise how much it cost to refrigerate the goods held during that period in cold storage. Furthermore, he is face to face with the questions: "What is my repair bill going to be for the year on my equipment? Will that equipment take me through another season as successfully as it did in the past one?" These are vital questions, and must be answered satisfactorily so that the manager can take whatever steps may be necessary to arrange his budget and prepare his plant so that it will meet efficiently and economically the demands that may be made upon it during the forthcoming season of intense activity.

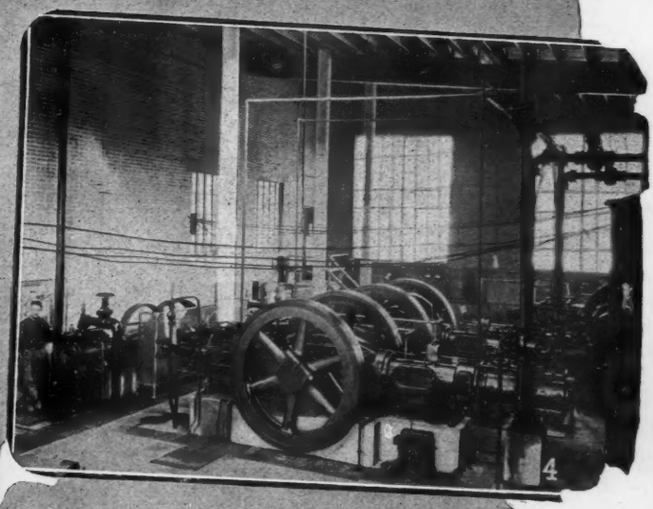
It is our custom each year to thoroughly overhaul our equipment. After this is done, a survey of the situation makes it plain to us where we stand. In our case the result of the survey has uniformly been satisfying, because it has shown that our prime units, especially, have stood up exceedingly well to the demands made upon them. As already mentioned, these prime units were furnished by the Ingersoll-Rand Company, while the freezing system was provided by the Henry Vogt Machine Company. We use high-pressure agitation in the ice tank. The plant has had four years of continuous operation. The figures for the cost of operation and maintenance are

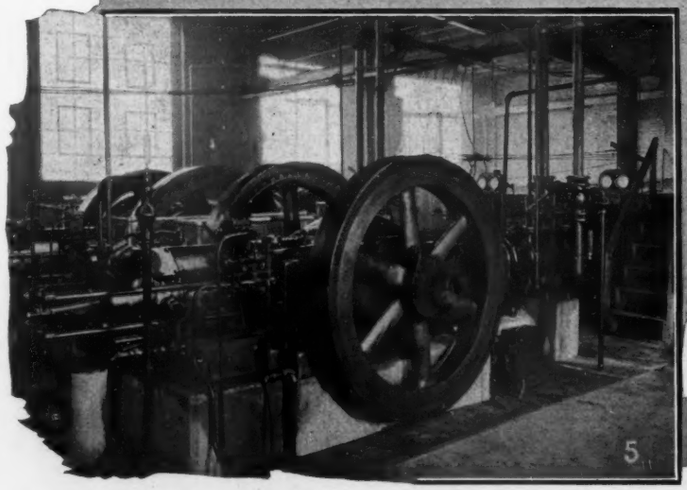


At the right are the two dehydrator units by which moisture is removed from the agitating air. At the left are the water filter and the large forecooler which lowers the temperature of the water nearly to the freezing point before it is delivered to the cans.







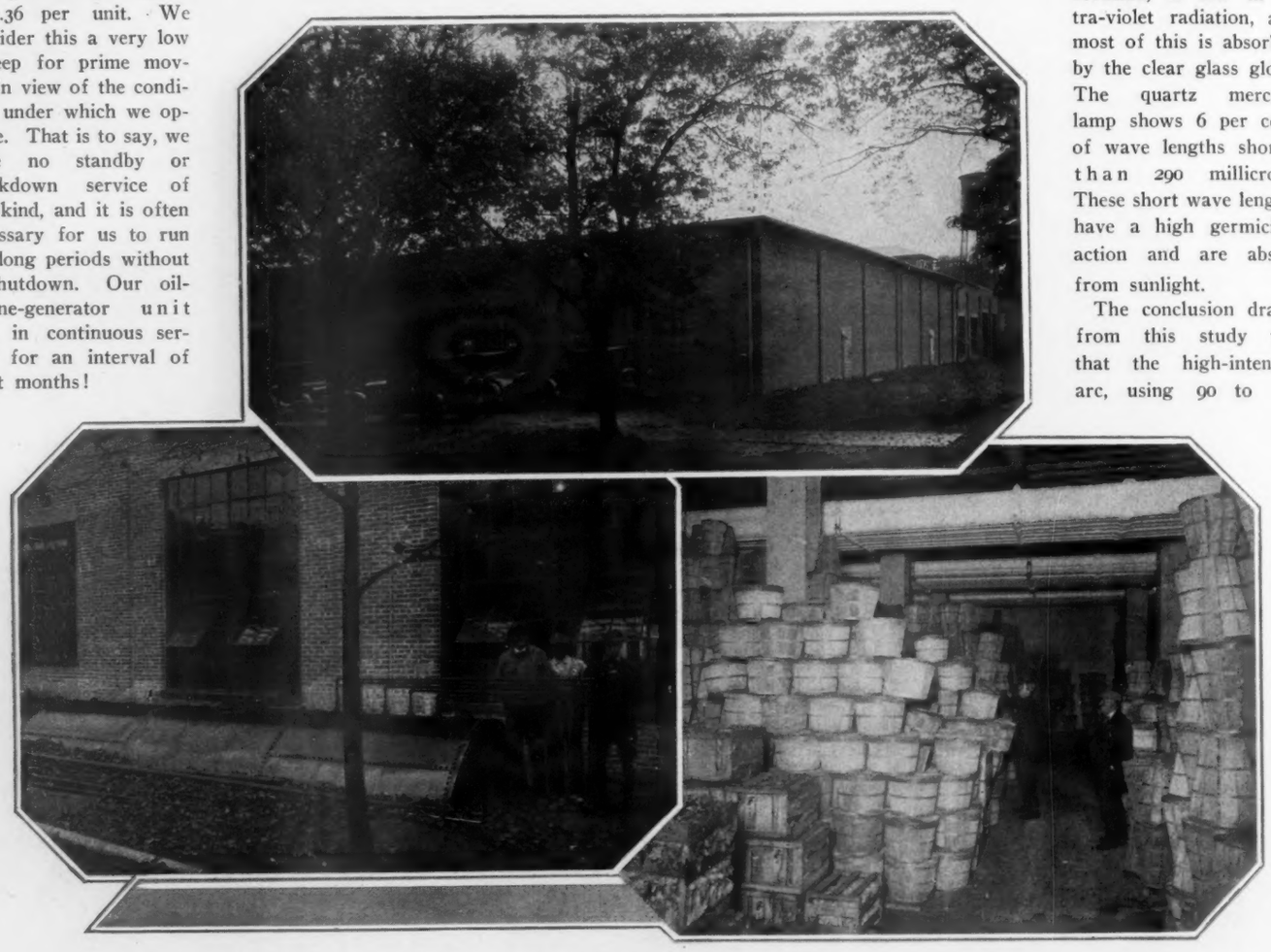


1—The ammonia receiver and the accumulator in the ice tankroom.
2—The 14x10-inch belt-driven compressor that furnishes air for agitating the freezing water and for operating the air lift at this up-to-date plant.
3—Filling ice cans with filtered and precooled Artesian well water.
4—Engine and compressor room of the Central Ice & Cold Storage Corporation's successful plant.
5—Two of the Ingersoll-Rand POC-1-A oil-engine, ammonia-compressor units in the Vineland plant of the Central Ice & Cold Storage Corporation.
6—Pumping out cores of forming ice cakes preparatory to filling them with fresh, clear water.

not only pleasing to us but interesting from an engineering standpoint.

During 1926, our engines consumed 63,717 gallons of fuel oil and 522 gallons of lubricating oil. The three main oil-engine units were in operation 15,099 hours out of a possible 25,980 hours. The fuel cost of operating these units was 24.12 cents per hour or approximately .25 cent per horsepower-hour; and the cost of lubrication was 1.8 cents per hour per unit. The maintenance of both oil engine and ammonia compressors averaged during the past year $109.36 per unit. We consider this a very low upkeep for prime movers in view of the condition under which we operate. That is to say, we have no standby or breakdown service of any kind, and it is often necessary for us to run for long periods without a shutdown. Our oil-engine-generator unit was in continuous service for an interval of eight months!

tory that we are now installing another POC-1-A unit of 51 tons refrigerating capacity so that we can increase our business. The intention is to separate the ice tank and the cold-storage departments. By this arrangement we shall obtain the highest operating efficiency. That is to say, we shall be able to take care of the cold-storage department and at the same time produce 60 tons of ice—10 tons more than we can make now. Our present plant is rated at 50 tons of ice, but it could pull 60 tons daily with the cold-storage department cut out. The new unit will take care of the cold-storage part of the business.



Top—Cold-storage department of the plant of the Central Ice & Cold Storage Corporation.
Left—Outside tank in which fuel is stored for the oil-engine units of the plant.
Right—One of the cold-storage rooms containing perishable foodstuffs from farms adjacent to Vineland.

During the year we produced 7,288 tons of ice at a cost of 36.5 cents per ton—that figure covering power, lubrication, lighting, refrigeration, and the operation of all the plant auxiliaries. In addition to manufacturing ice, we refrigerated 125,000 cubic feet of cold-storage space at a temperature of 32° F. and 25,000 additional cubic feet of cold-storage space at 20° F. In the course of 1926, there passed through our storage rooms 80,650 packages of fruits, vegetables, and other perishable commodities. We are confident that we can repeat our past performances for the next four years and maintain our equipment in its present state of service.

Our equipment is and has been so satisfac-

PROVE CURATIVE POWERS OF ARTIFICIAL LIGHT

THE carbon arc lamp gives light nearest approaching sunlight, it has been determined by the United States Bureau of Standards. This knowledge is of importance because of the widespread efforts now being made to utilize the sun's rays and their substitutes in the healing of certain forms of disease. As the beneficial effects of sunshine cannot be obtained at all times and in every desired place, research was conducted looking to the discovery of a source of ultra-violet radiation that has most nearly the same ultra-violet spectral energy distribution as has the sun.

It was found that while the light of the carbon arc comes nearest to being like sunlight, some types of carbon electrodes give a much closer approach to the solar spectral energy distribution than others. It also was determined that the spectral quality of the energy radiated depends largely upon the size of the carbon and upon the current used.

A gas-filled tungsten lamp, so research has revealed, is low in ultra-violet radiation, and most of this is absorbed by the clear glass globe. The quartz mercury lamp shows 6 per cent. of wave lengths shorter than 290 millicrons. These short wave lengths have a high germicidal action and are absent from sunlight.

The conclusion drawn from this study was that the high-intensity arc, using 90 to 125 amperes, will be useful in therapeutical treatment. It was declared, however, that by employing the proper kind of metal-cored carbon electrodes at the right working distances the same relative proportions of ultra-violet and total radiation can be obtained from a 20-ampere arc as from a high-power installation. All requirements of light therapy can be met in this manner.

What is said to be the longest highway bridge is now being built across Carquinez Strait, California. The bridge proper will have a length of 3,350 feet and will join a viaduct and highway approach about 1,400 feet long.

Canadian Superservice Station Makes Extensive Use of Compressed Air

By THE STAFF

COMPRESSED air does many useful things in a new automobile service plant recently opened in Montreal. Designed along the lines of the so-called superservice stations in other large cities, and fitted out with the most modern equipment, this plant is the result of two years research on the part of its engineers and owners, the Automotive Utilities, Ltd. In designing, every effort was made to provide for the comfort of waiting patrons, and to put the operations of washing, cleaning, greasing, etc., on a businesslike basis. The laundering of cars is handled on the progressive or stream-line system, such as is now practiced in many modern factories.

Located in Montreal's new Automobile Row Building, in the heart of the automobile district, the new service station is ideally situated. Upon entering, the customer is greeted by a salesman, who notes on a job ticket the work to be done. This card, which bears a list of the various services to be rendered and the cost thereof, is hung on the car in a leather holder and acts as a claim check. The owner is then ushered into a well-appointed waiting room, or he may inspect the plant, or watch cars being laundered.

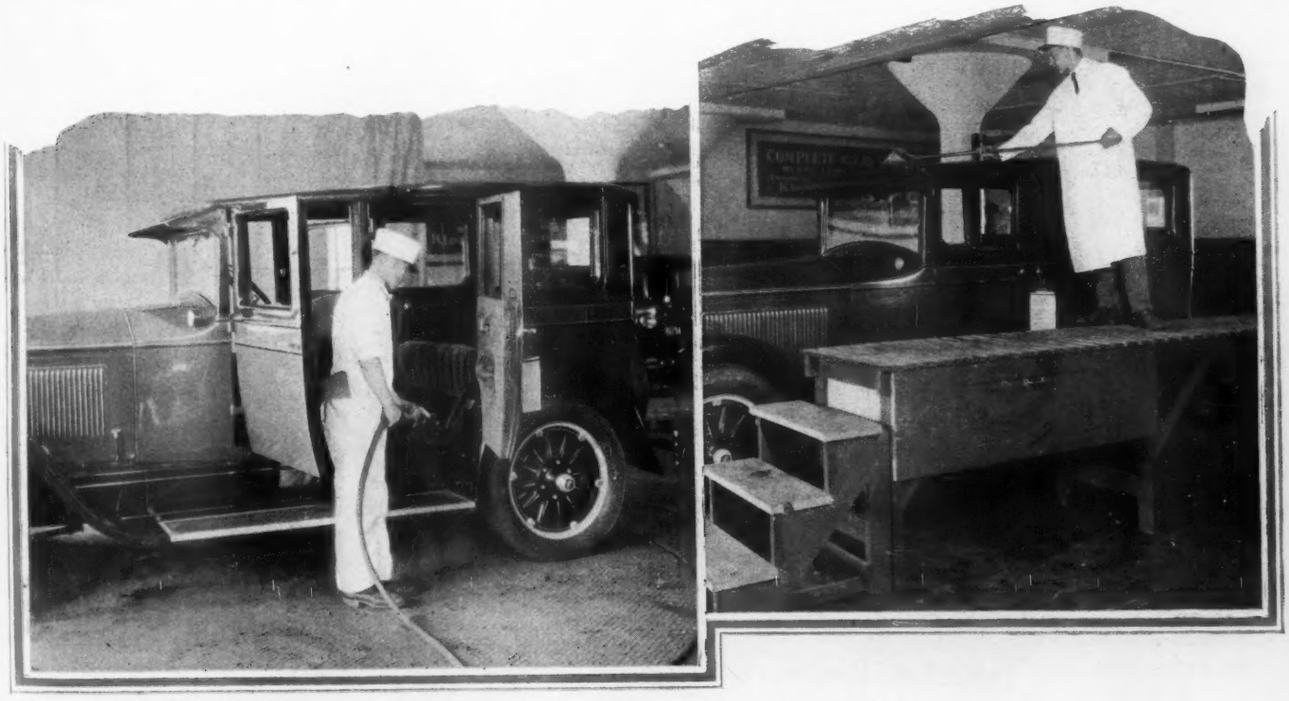
His car, meanwhile, is passed to the first operator, who cleans and polishes the top. It is then run on to a turntable, where the interior and the upholstery is well cleaned with compressed air—the dust being drawn out of the building by a large exhaust fan. This turntable is 14 feet across, and is supported in the center by a taper roller bearing and near the edge by a series of roller-bearing casters, which run on two circular steel tracks. When this work is completed, the car is pushed on to the wash rack or "cleaning line" that is separated from the rest of the establishment by glass partitions. At this point the vehicle is hoisted by means of an automatic lift. This raises the car to a sufficient height to permit of ready access to all parts of the chassis and to allow the wheels to be rotated for easy cleaning. Four men thoroughly clean the underbody with what is known as the "Klean-Rite Pressure Vapor and Soap Solution"—a combination of compressed air, soap, grease solvent, and water—so that the parts usually neglected are made as bright and clean as the parts that are seen. While the car is in this position a man on each side of it sprays the springs, body pads, shackle bolts, and the spaces between the fenders and the body with a penetrating oil applied under high pressure.

The car is next lowered to the floor level and moved on to the body washers, who rinse and sponge the body. For this purpose is used only hot and cold water, thus preserving the surface finish to a marked degree. From there, it is run on to the chamoising department, where three men rub down the body and clean the windows while two others polish the nickeled parts with rotary buffers, producing a very high luster. Finally, the car passes the inspector, who examines the work done and blows off any surplus water on the chassis or around the hood, etc., by the aid of a compressed-air gun. By this time the automobile is standing spick and span outside the waiting-room door; and, unless it is to go to one of the other departments for further attention, the customer pays his bill, is given a receipt, and goes on his way rejoicing.

Operating air for the washing equipment is supplied by two Class ER, short-belted, motor-driven compressors—the air being stored in two large receivers coupled together. One of the compressors, a 6x6-inch unit, furnishes enough air for all requirements. The smaller 5x4-inch machine is provided as an auxiliary, thus assuring a continuous supply of air even in case it is necessary to shut down the large compressor. This stand-by can also be used when more than the usual amount of air is needed.

Cold water is furnished at high pressure by means of two cold-water vaporizers and two 450-gallon tanks, which are drawn upon alternately. A special oil heater, equipped with a 250-gallon storage tank, delivers 420 gallons of hot water per hour—the heater for this tank burning filtered crank-case drainings with a consequent saving in operating costs.

Soap solution and grease solvent, two essential materials, are made on the spot in automatic soap- and grease-solvent mixers and stored in tanks. The five materials—that is, hot and cold water, soap solution, grease



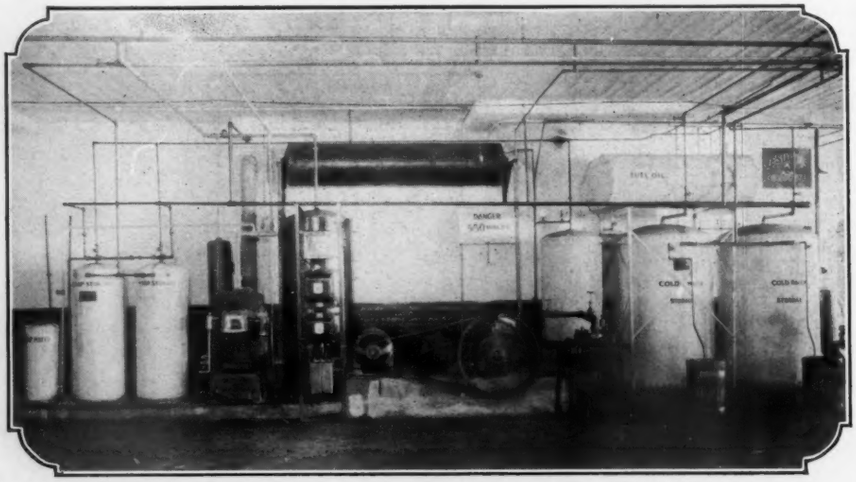
Left—Air at a pressure of 125 pounds is used in cleaning the interior of a car. Right—Method followed in cleaning and polishing the tops of cars.

solvent, and air—are piped to every corner of the chassis-washing department. The separate pipes terminate in a mixing chamber where any combination of the various ingredients can be provided by the aid of quick-action valves. The mixture is discharged through a hose fitted with a special nozzle that applies all the materials in vaporous form.

The wash rack is 45 feet long and 15 feet wide, and is drained from either end to the center by a 3x2-foot catch basin. The tracks on which the cars run slope down to the finishing end, thus making it possible to push the vehicles along from department to department with very little effort. The side walls of the "cleaning line" are 5 feet high and surmounted by glass partitions that extend all the way to the ceiling—permitting customers to watch the car-washing procedure without the danger of being splashed.

The lighting system for the wash rack, as well as for the lubricating department, is the result of considerable study and experiment, it being realized that heretofore lighting has been a weak point in many stations of this kind. As a consequence, 34 special, holoplane, vapor-proof globes with 100-watt lamps are suspended from the ceiling at a height of 8 feet from the floor level and at an angle of 15 degrees toward the car. One of the advantages of the system is the total absence of glare; and it likewise eliminates spot lights which not only throw heavy shadows but are cumbersome and take up valuable space. Lights other than those on the ceiling are not necessary, thus leaving the rack walls clear.

In addition to the laundering department, the plant of the Automotive Utilities, Ltd., is fitted to supply everything except mechanical service. Motor cleaning, which is very popular, is also done in a special department. No one department in the establishment is stressed more than any of the others, the whole scheme of things being to sell the customer along the idea of complete service; and he is shown how such service will cut depreciation costs to a minimum.



Washing equipment employed in this type of up-to-date auto laundry insures clean cars.

JAPAN EXPLOITING HER SHALE-OIL DEPOSITS

AFTER protracted and satisfactory laboratory work conducted at the Fushun Collieries, Fushun, Japan, the first fire was built, in the latter part of 1926, under an experimental shale-oil distillation furnace at that plant. This furnace is 3 feet in diameter and 50 feet high, and has a capacity of 40 tons. It is of the internal heating type, and is so designed that the gas will be returned to the furnace for re-use. An appropriation of about $145,000 was made for this initial undertaking.

If the 40-ton furnace comes up to expectations—that is, if it yields an oil equal in quality to that produced by the original 10-ton test furnace, the plan is to build forty-seven additional 40-ton furnaces at an expenditure of from $2,000,000 to $2,500,000. Present indications are that the work of construction will soon be begun.

It was found at the Tokuyama fuel depot that by mixing one part of the shale oil produced at the Fushun Collieries with two parts of crude Borneo oil, that a product was obtained that would be entirely satisfactory for marine purposes. Besides shale oil, of which an annual output of 25,000 tons is expected when the plant is completed, by-products such as crude paraffin, sulphate of ammonia, and coal tar will be obtained. The shale from which the oil is extracted is found in great quantities at the Fushun Collieries; and because it lies between the coal seam and the overburden it can be mined at low cost. It is said that the successful exploitation of these deposits will make Japan far less dependent than she now is on outside sources of heavy oil.

Washing the chassis with the "Klean-Rite" pressure vapor and soap solution—a combination of compressed air, soap, grease solvent, and water.

VENTILATION A SALES BOOSTER

SYSTEMATIC control of the air supply in big department stores has proved a sales booster for the La Salle and Koch Company, of Toledo, Ohio, according to Howard E. Lovett, engineering head of the firm. Twenty-four million cubic feet of conditioned air, weighing 800 tons, is supplied to the store every hour. It is taken from above the roof, washed, heated, and humidified, and introduced into the various portions of the building by means of ducts and registers. Air washers and air filters—the latter consisting of steel shavings saturated with oil—are utilized to cleanse the air of dirt and dust. The vitiated air is withdrawn from the building mechanically.

The air supply is heated or cooled, depending upon the particular department in which it is to be used. In the candymaking department, for example, it is maintained at 68°F. and at a humidity of 40 per cent., while that distributed to the vaults containing furs is at a temperature of 28°F.—that is, 4 degrees below the freezing point of water. This temperature has been determined to be most favorable to the preservation of furs.

This mobile, pneumatic frame-washing outfit has greatly simplified the cleaning problem in one of the yards of the Chicago, Milwaukee & St. Paul Railroad. One man can now clean both frames on an electric locomotive in a couple of hours where previously, without this apparatus, it took five laborers the same time to do the work.

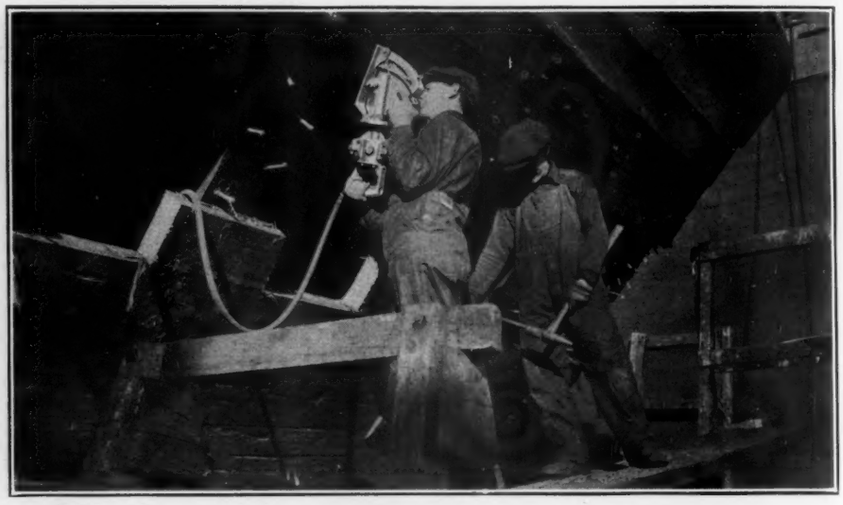
AIR-DRIVEN HAND SAW OF IMPROVED TYPE

A PORTABLE hand saw that combines a dependable air motor and an approved safety guard has recently been placed on the market. It is designed for general use, and is expected to find favor among carpenters, contractors, lumber yards, railroads, shipping rooms, and the like. Savings of from 50 to 75 per cent. in sawing costs can be effected by its employment, it is claimed.

The saw is operated by an I-R, 3-cylinder type of air motor of the same design which has long been used in I-R grinders and lightweight drills. It is a smooth-running, economical unit which is particularly free from operating troubles. All its wearing parts, including the cylinders, are renewable.

An important feature is the Crow saw guard, which has been found to meet all safety requirements. It has been approved by the Pennsylvania Department of Labor & Industry, the Ohio Industrial Commission, the New Jersey Department of Labor, and the Underwriters' Laboratories. This guard —of telescopic nature— opens when the saw is pushed into the material. As the cut is completed, it automatically closes and locks, thus giving complete protection against accidents and against damage to the blade. It has an adjustable stop which permits setting it for the desired depth of cut.

The saw is being made in three sizes, and will take 6-, 8-, and 12-inch blades. Crosscut or rip blades, or combinations of the two, are procurable. Blades are also provided for sawing soapstone, Bakelite, cable, copper, wall-board, and other resistant materials. The new saw is being marketed by the Ingersoll-Rand Company, 11 Broadway, New York City.



Safety air saw facilitates the work of cutting out end planking on a barge.

Air-driven saw ripping 4-inch planking for use on barge repair work.

Cutting out timbers with the safety air saw in repairing a dock.

Entomologists have long known that the communal life of the bee is exceedingly complex and deserving of the closest study. It is therefore of interest to learn that two Germans, von Frisch and Roesch, have succeeded by the aid of "movies" in revealing something of what goes on in the beehive. The pictures show hive dances in progress, with sentries guarding the door. In one of the scenes is portrayed a spirited battle between a posted sentry and a wasp that tried to enter the hive.

Lightship *No. 111*, recently placed off the entrance to Delaware Bay, is the first vessel in the United States Lighthouse Service to be propelled by a heavy-oil engine. The craft, which has a displacement of approximately 788 tons in salt water, makes use of compressed air in a number of directions. The engine is reversed by compressed air; the sanitary and the fresh-water systems are pneumatically operated; and the fog signal apparatus carried is of the air-driven type.

To shorten the rail haul and to obviate the transshipment of commodities, the Antioquia Railway Company has awarded a contract for the construction of a 2-mile tunnel, through hard rock, between Santiago and Limón, Colombia. The cost of the undertaking is estimated at $2,000,000.

Great Northern Railway Driving Long Tunnel Through Cascade Range

General Description of the Tunnel and Operating Methods at the West Portal and Mill Creek

PART II

By ROBERT G. SKERRETT

THE main pioneer tunnel and the main railroad tunnel are 66 feet apart from center to center—the pioneer tunnel being parallel with and to the south of the main tunnel; and crosscuts are driven every 1,500 feet in from the portal. Work on the inclined adit was started with air furnished by I-R portables; and these machines supplied motive air to the rock drills until the stationary compressors in the powerhouse nearby were able to take over the load. Three 360-H. P. Diesel engines drive three alternating-current generators which, in their turn, furnish current for lighting and mucking and for operating the air compressors, of which there are five at the West Portal with a combined output of 4,750 cubic feet of delivered air a minute. The Diesels were originally put in as a temporary aid until the Puget Sound Power & Light Company could deliver current over a high-tension transmission line, then being extended to Scenic from the company's Beverly Park Powerhouse. The line delivers alternating current at 13,200 volts, which is stepped down to 2,300 volts. Motor-generator sets in the Scenic powerhouse produce 250-volt direct current for use in mucking and hauling operations.

After current was available over the high-tension line, the three Diesels were retained as emergency units because, with an efficiency of 84 per cent. at the switchboard, they can take care of approximately seven-eighths of the plant's normal load. Just what this might mean was strikingly exemplified in the latter part of November last when a large tree fell across and broke the high-tension line—putting the line out of service for three days. The Diesels came to the rescue and saved the day just when every hour meant so much tunnel advance.

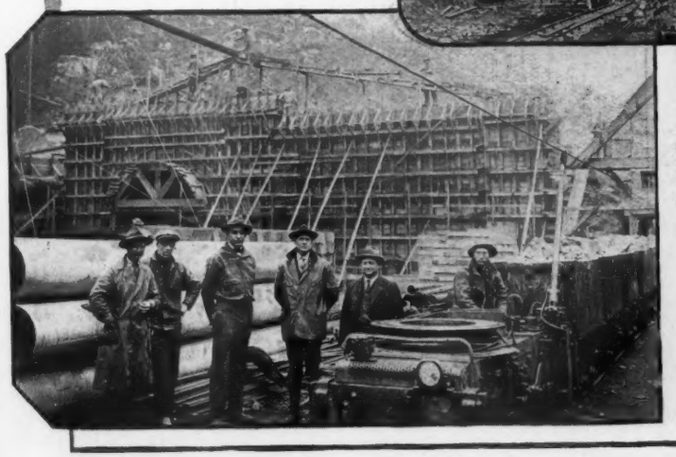
The rock at the West Portal is gray granite interspersed with rock that is decomposed and soft; and the changing character of the rock has compelled modifications in the method of attack originally contemplated. For instance, the idea was to advance the main tunnel by center headings, because, under favorable conditions, this method lends itself to radial drilling and ring shooting in enlarging to full tunnel size. Furthermore, it makes continuous enlargement mucking operations practicable. As Colonel Mears points out: "In order to have uninterrupted drilling for this operation three things are essential: First, the center heading must be well advanced; second, there must be no interruption in the air supply for the drills; and, third, the drillers must have a means of retreat."

Matters did not work out as designed at the West Portal, because Nature interposed

Top—An early view of the main-tunnel and the pioneer-tunnel portals at the west end of the new Cascade Tunnel.

Left—At the West Portal. From left to right, W. E. Conroy, H. J. King, R. F. Hoffmark, Col. F. Mears, and M. J. C. Andrews.

Right—Workmen's camp at the West Portal.



difficulties in the form of bad ground. As we have already explained, an inclined shaft or adit was used to make a start on the pioneer tunnel at a point 2,270 feet from the West Portal; and it was not possible to employ a 10x10-foot center heading in the railroad tunnel until after an advance of 1,100 feet had been made from the portal to Crosscut No. 1. That advance was effected with a top heading and with the usual timbering, as shown in some of our illustrations. From Crosscut No. 1 onward, a center heading was driven in the main tunnel in the hope that it would be feasible to enlarge directly from it, but it was found that the ground would not hold. It therefore became necessary to again drive a top heading through that bad stretch and to resort to timbering. In enlarging, the rock intervening between top and center headings is dropped into the center-heading cavity. Where the bench is solid up to the spring line it is drilled with top and bottom holes. Top holes on the bench are drilled about 7 feet deep, while lifters are drilled from 8 to 12 feet deep, depending upon the nature of the rock. Top holes are fired first.

The corps of cooks and waiters at the West Portal Camp who see to it that the workers have an abundance of appetizing food ready for them at meal times. In their way, these men are rendering an essential and an important service in advancing the tunnel.

In the center headings of the main tunnel and in the pioneer tunnel at West Portal, the drilling is done on drill carriages mounting four drills—the drills being left on the carriages when they are withdrawn before shooting. These carriages are modeled after those in use in the Moffat Tunnel in Colorado and were originally designed by engineers of the Ingersoll-Rand Company. Where drill carriages are employed it is necessary to finish the mucking at a heading before the carriage can be returned to the face for the resumption of drilling. The time between a shot and the return of the carriage to start drilling again is from two to two and a half hours. In top-heading work the drills are mounted on bars; and in enlarging, a bar set-up is used for drilling.

Drill rounds in center and pioneer headings vary from 26 to 34 holes, depending upon the character of the rock; and the depth of the holes runs from 10 to 14 feet. About five 50-pound cases of 60 per cent. dynamite are used per round. The charges are fired in six relays in the drifting operations—the footage pulled ranging from 7 to 9 feet at a round. As many as ten relays are used in the full-size tunnel work.

Mucking in pioneer- and center-heading drifts is done by electrically operated Myers-Whaley machines, which load into 2-yard cars. These cars are moved to and from the headings upon track of 2-foot gage; and the hauling is done by 6-ton electric locomotives generally operating with a trolley. However, each locomotive is equipped with a reel capable of holding about 500 feet of cable; and current is supplied in this way to the driving motors when the locomotive approaches a heading.

When within a few hundred feet of a heading, the single, 2-foot-gage track is doubled to facilitate the advance of empty muck cars and the withdrawal of loaded ones. The two adjacent rails of the two tracks are spaced 2 feet apart—virtually making three tracks; and on the center track the mucking machine and the drill carriage operate.

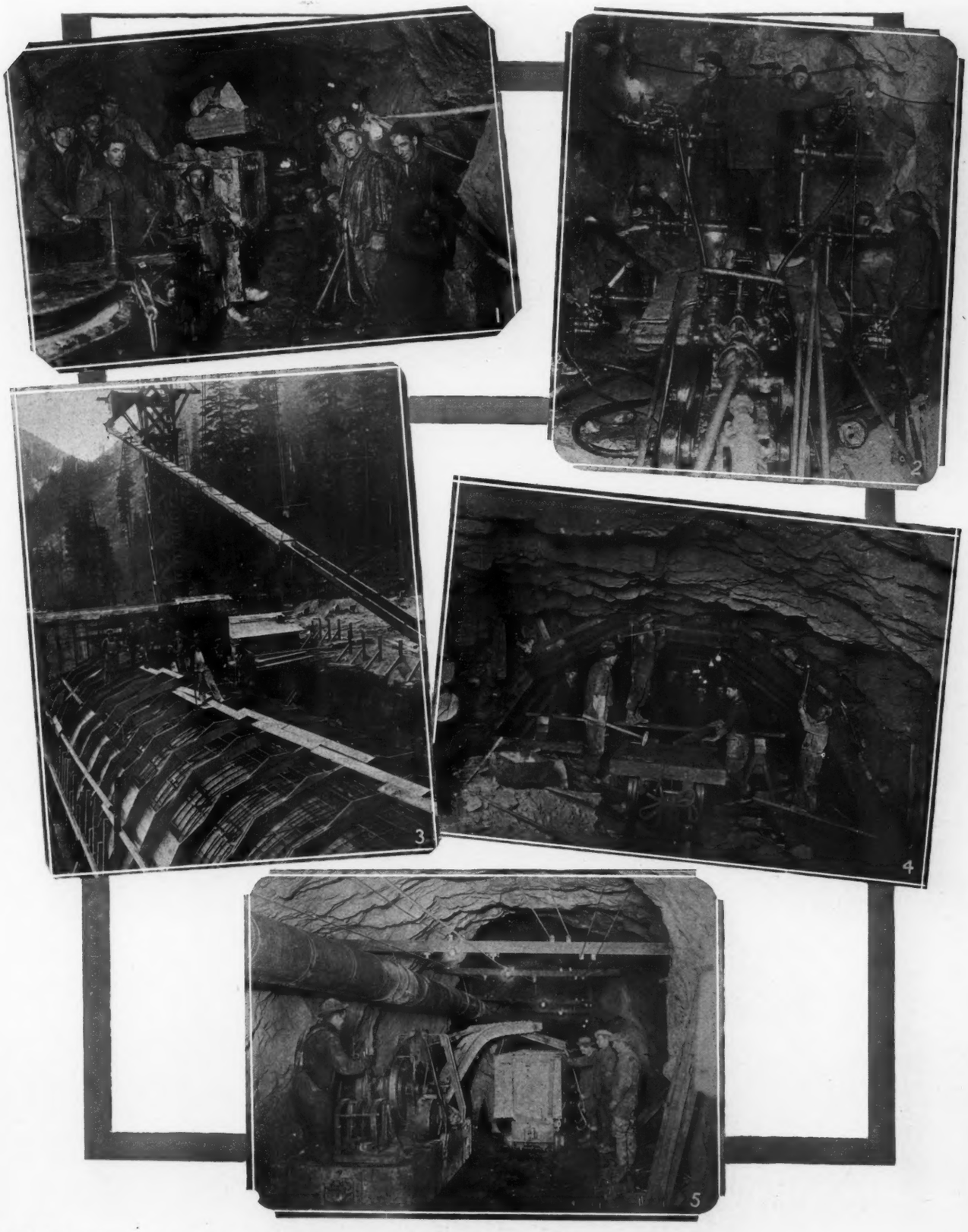
In an effort to speed up the shifting of unloaded 2-yard muck cars from the stand-by track to the loading track to the rear of the shovel loader, the engineers of A. Guthrie & Company, Inc., designed a special, mobile car-transfer machine. This machine—familiarly called a "cherry picker"—is equipped with an air-operated hoist and a derrick, and the cars are picked up by hooked slings suspended from a horizontal angle bar. An average of about 750 yards of muck is handled daily at the West Portal, and this is used for fill in the tunnel approach.

The rock so far encountered in driving the tunnel is a granite formation which has varied considerably at different points. As a rule, the outer mass of the rock structure is hard, genuine granite; but farther in, owing to the combined action of great heat and enormous pressures, the rock is altered and consists principally of quartz diorite. Occasionally, seams of talc have been met; and these seams have necessitated timbering even in center headings owing to the instability of this ground.

Mucking at the main tunnel enlargement is being done by an air-operated Marion shovel, Model 41, mounted on caterpillars. The shovel was modified somewhat to meet conditions, and has performed well. At the rear of the shovel there is a derrick, also operated by air, which shifts the 6-yard Koppel side-dump cars from the waiting to the loading position. The trains of 6-yard muck cars are hauled, on 3-foot-gage track, by 20-ton General Electric locomotives drawing current by trolley. Two of the locomotives in use have storage batteries in reserve so that they can carry on for a while in case there is a breakdown in the supply line overhead.

These comfortable cottages have been erected for the married men at the West Portal Camp.

Some idea of the rate of advance made possible by efficient machinery and energetic workers can be gathered from the performance of crews in the 8x9-foot pioneer tunnel at the West Portal during the month of August, 1926. In 31 days an advance of 937 feet was made—



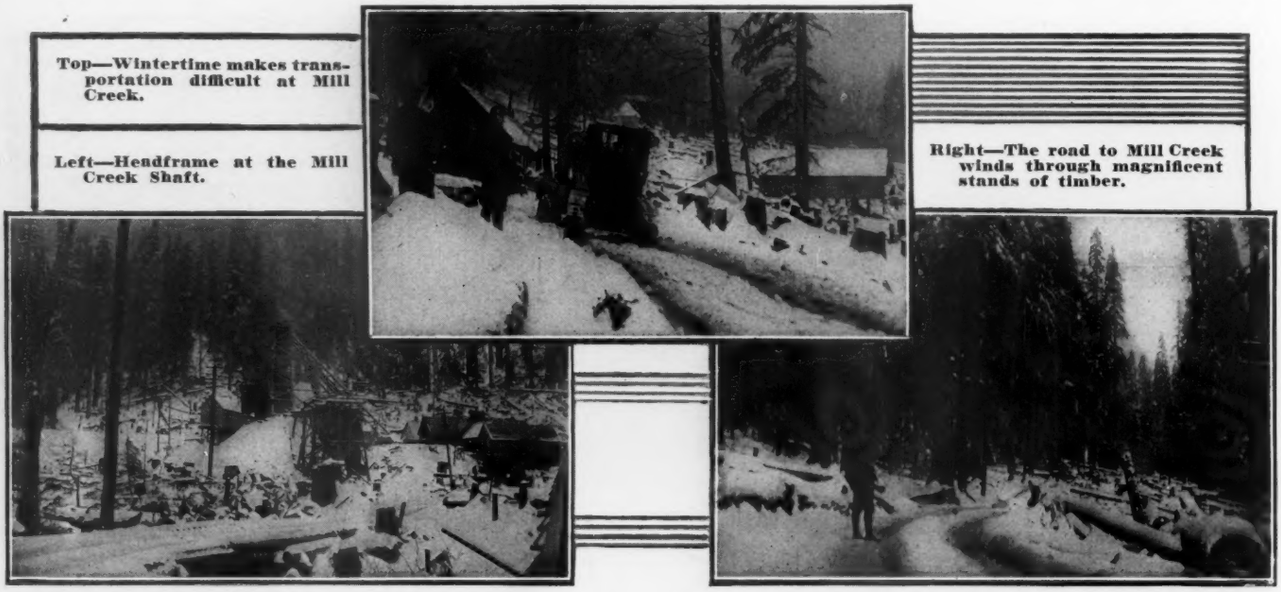
1—Mucking machine, muck car, and electric locomotive at one of the West Portal headings.

2—Set-up of drills on a drill carriage at one of the headings in the pioneer tunnel at the West Portal.

3—Forms and reinforcing steel in place preparatory to pouring concrete at the West Portal entrance to the main tunnel.

4—Timbering a top heading in the main tunnel at the West Portal.

5—"Cherry picker" used to lift empty cars from the stand-by track to the loading track preparatory to running them up to the mucking machine.



Top—Wintertime makes transportation difficult at Mill Creek.

Left—Headframe at the Mill Creek Shaft.

Right—The road to Mill Creek winds through magnificent stands of timber.

establishing a world's record for drifting. Again, in October last, an advance of 1,157 feet was made in 31 days in the same pioneer tunnel—another world's record for footage in a drift of that size.

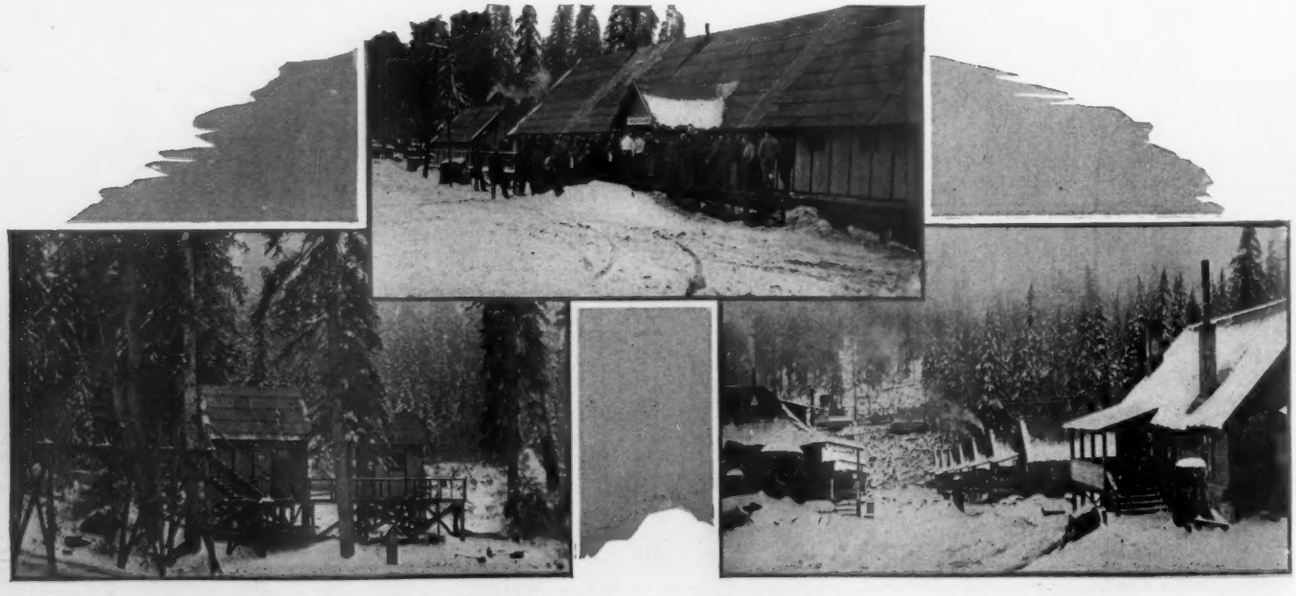
The West Portal tunnels are lighted by electricity and ventilated by electrically driven blowers distributing air to the headings through 20-inch galvanized pipe secured with banded slip joints. The main blower has a capacity of 20,000 cubic feet a minute; and a booster, of 5,000-foot capacity and similar drive, is placed in from the portal every 5,000 feet. Usually the blowers discharge fresh air at a point a short way back from a heading; but in this case their action is reversed, and they draw air from a heading for a while following a shot. Also, just before a shot, the compressed-air line is opened at the heading; and the joint action of the blowers and the exhausted compressed air tends to clear up the air at the heading so that operations can be resumed there within from 15 to 20 minutes after a shot. When a certain penetration has been attained in the West Portal, air will be forced in through the pioneer tunnel and out through the enlarged main or railroad tunnel. To facilitate this, some of the crosscuts will be sealed. Likewise, a fan will be placed in the crosscut nearest the dead ends to force air up to the headings.

Compressed air is carried into the West Portal workings by an 8-inch line, which is reduced to 4 inches at the crosscuts and again reduced to 3 inches near the headings—the final 50 or 100 feet of air main being rubber hose. Air-line joints are made with flexible couplings; and the compressors are set to "pop" at 120 pounds.

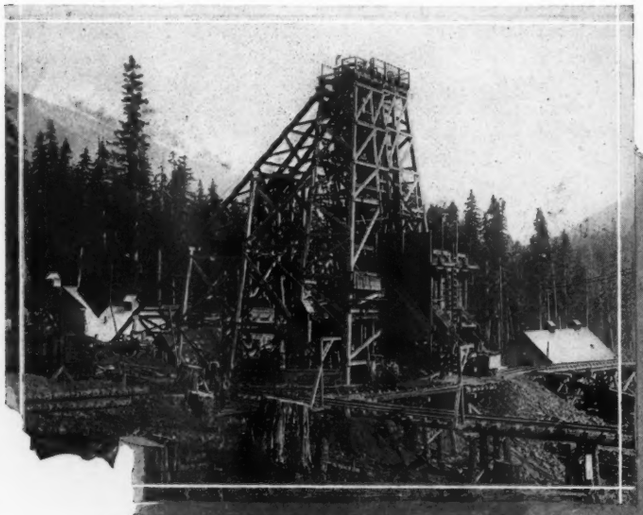
In the West Portal, generally, little trouble has been experienced because of inflowing water; and a few small air-operated piston pumps have been able to take care of the seepage so far—most of the water in the main tunnel being got rid of by gravity flow. The one exception was a pocket opened up above an extensive seam of talc, from which water flowed for half an hour at a rate of 1,000 gallons a minute. Cameron sinkers handled the water during the driving of the inclined adit.

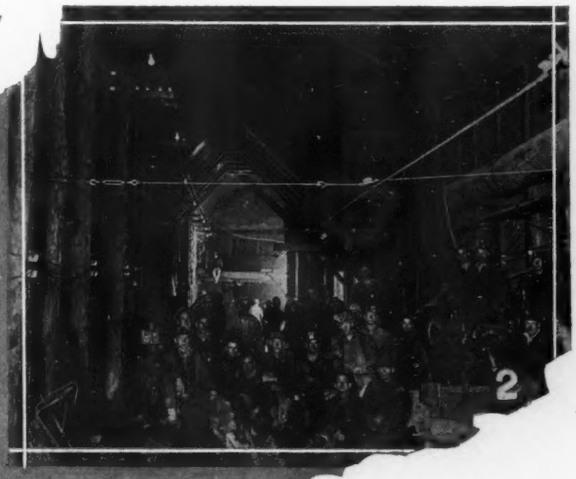
The blacksmith shop at the West Portal is equipped with three oil furnaces for heating and tempering the steels; and the sharpening is done by two air-operated sharpening machines. All told, an average of 1,460 steels is treated at the shop in the course of a 3-shift day. Steels are changed every 30 inches. The starting size of the bits is 2½ inches; and the gage is reduced ⅛ inch at each change of steel.

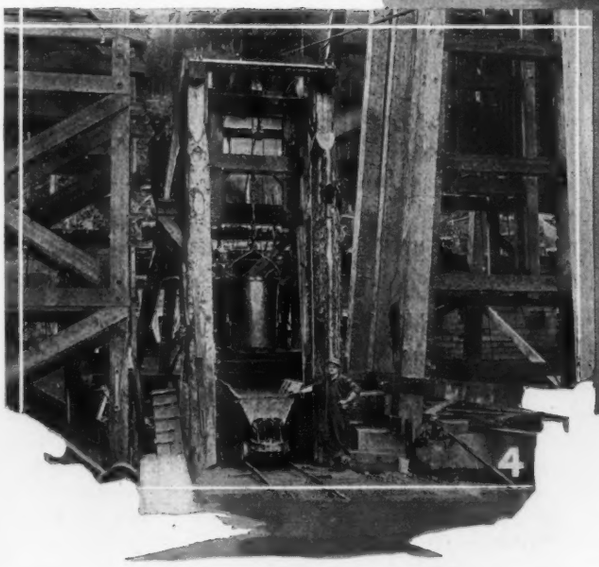
Work at the West Portal, on behalf of the



Top—"Chow time" at Mill Creek Camp.
Left—Powder "make-up" house at Mill Creek.
Right—Cottages for married workers at Mill Creek.







1—Towering headframe at Mill Creek Shaft built with timbers cut in the surrounding forest.
2—Timbered section of main tunnel contiguous to the shaft at Mill Creek.
3—Electrically driven hoist at Mill Creek.
4—Bucket suspended from temporary headframe that was used for the sinking of the deep shaft at Mill Creek.
5—On an inspection tour at Mill Creek. Reading from left to right: M. J. C. Andrews, J. B. Renwick, W. E. Conroy, F. J. Kane, R. F. Hoffmark, Charles Ffolliett, and H. L. Mundy.

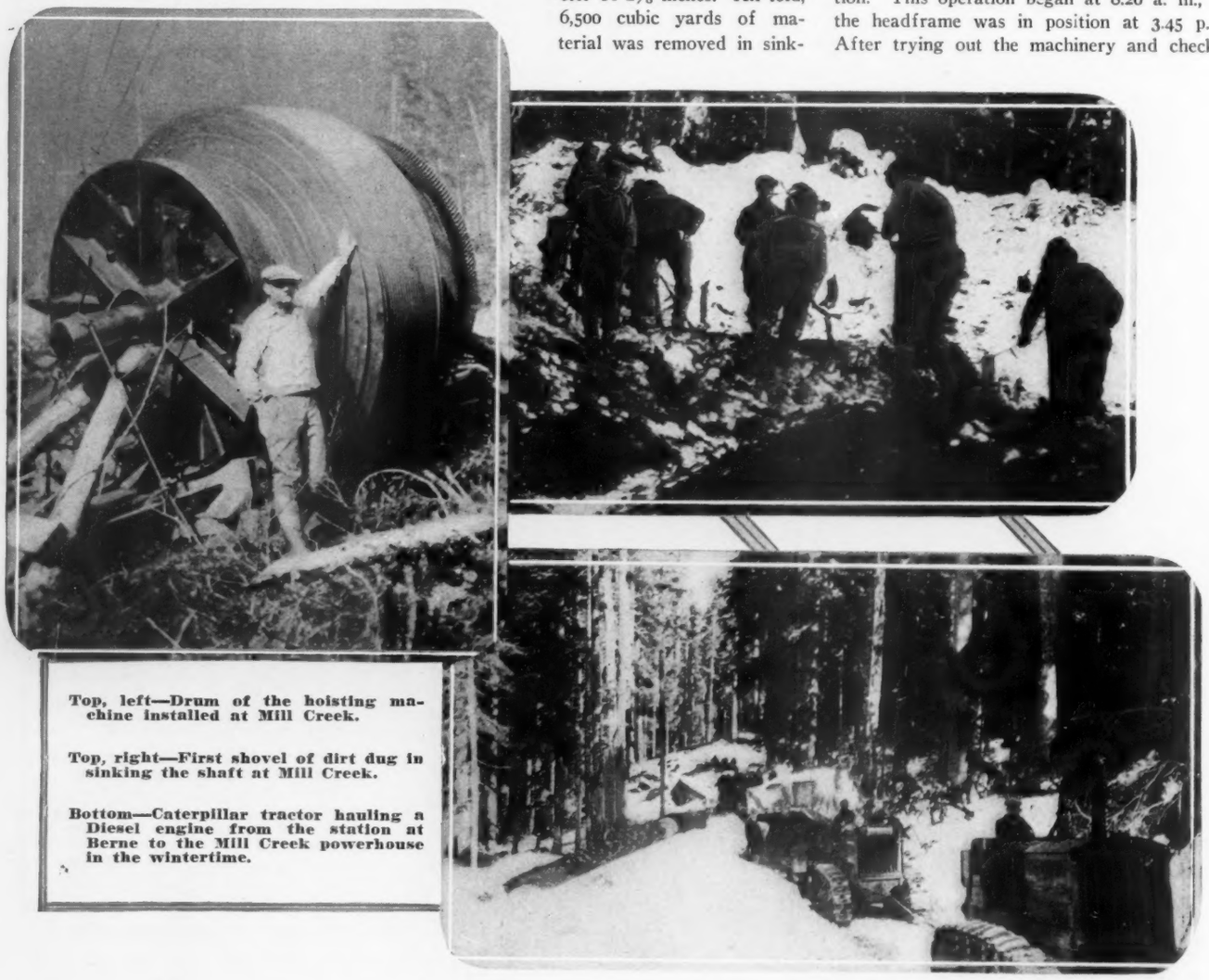
contractor, is under the immediate supervision of Mr. H. J. King. Inasmuch as operations at the Mill Creek Camp follow, in their westward course, substantially the same method as that adopted for progress eastward from the West Portal, it might avoid confusion if we next described activities at Mill Creek.

To reach the tunnel line beneath Mill Creek Valley, it was necessary to sink an 8x24-foot shaft to a depth of 622 feet. The shaft was carried to an ultimate depth of 659 feet to provide for storage bins and loading pockets at the bottom, as well as for a sump into which to drain the water. The sinking of this shaft—which is heavily timbered—was begun February 8, 1926, and was finished on July 15, following. This was remarkably quick time; and during the month of June an advance of 158 feet was made. Air for the sinking of the shaft was furnished at the start of operations by I-R portables; and air was supplied from the same source until the work had been carried down 180 feet. After that air was available from the regular power plant in which are installed four electrically driven compressors having a total output of 3,838 cubic feet of air a minute.

The ground penetrated is a granite-schist formation. At a depth of 200 feet a seam of water was reached that exerted sufficient force to knock over the drill runner and his machine and then to rise from the drill hole to a height of 60 feet. There was an area of 30 feet in the shaft within which it was possible to shoot only by putting the charges in galvanized-iron pipes and by driving those pipes into the holes against the water pressure to the necessary depth. In sinking the shaft, holes were drilled to a depth of 8 feet at a round, starting with bits having a diameter of 2⅜ inches. All told, 6,500 cubic yards of material was removed in sinking the shaft. Cameron No. 9 sinkers were used to drain the shaft during its sinking.

At the start, all hoisting was done from the shaft by a donkey engine. The height of the timber headframe was 25 feet, and the bucket employed had a capacity of 16 cubic feet. While that frame was in service, another much larger headframe was constructed for work in connection with the hoisting plant now operating. The big headframe was built off at one side of the shaft, and was made from timbers cut from the adjacent forest and hewed to shape by hand. The heaviest of these timbers measure 18x18 inches at their butts and are 12x12 inches square at their small sections. The big headframe has back legs 114 feet long—all single timbers; and the legs of the tower, which is 87 feet high, are also single sticks. This structure was erected on sills, 107 feet long, which rested on other timbers buried in the ground and which were designed to act as launching ways in shifting the headframe 26 feet so as to land it in its final position over the shaft mouth. Half-inch holes were bored in the sills so that Alemite grease might be forced in between the two sets of timbers by means of a lubricating gun. Screw jacks were used to move the headframe into its final position. This operation began at 8.20 a. m., and the headframe was in position at 3.45 p. m. After trying out the machinery and checking the cable for distances, the first bucket was raised by the new hoist at 10.45 p. m. the same day.

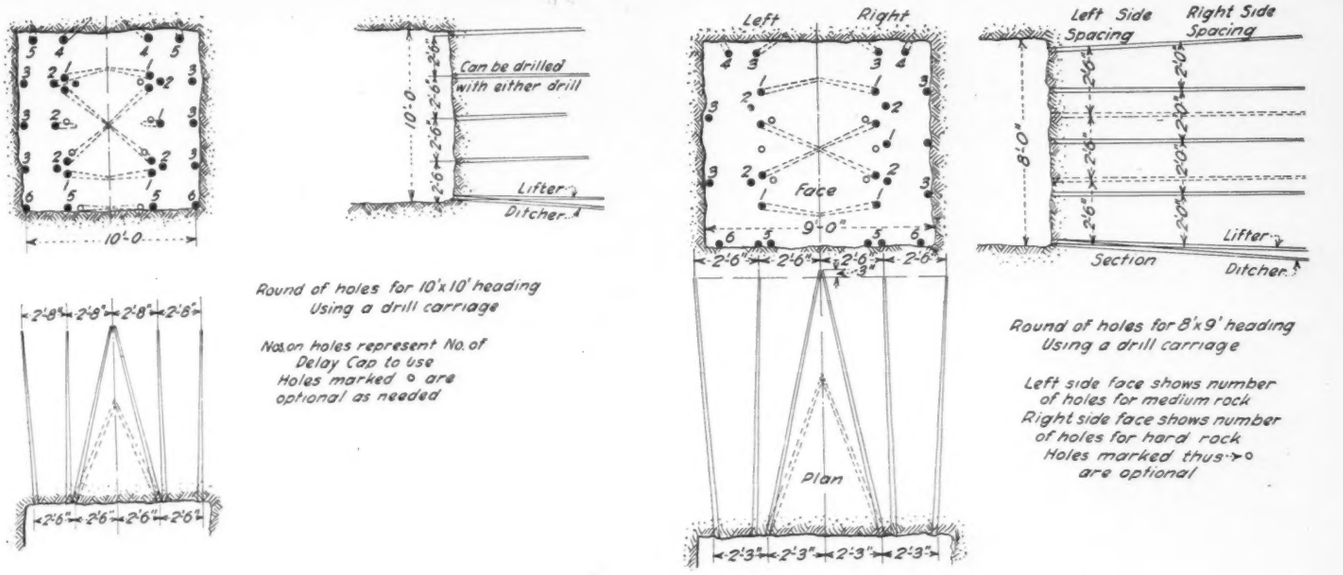
The main hoist is operated by a 350-H. P. electric motor; and the speed of the cable over the hoist drum is 1,400 feet a minute. The hoist is of the balanced type—that is, it is provided with two skips, each of which has a capacity of 70 cubic feet. The man-hoist is also operated electrically. The shaft is divided into four passageways. Two of these are used by the muck skips; in another the man-cage operates; and in the fourth passageway are run the two 20-inch ventilating ducts, the compressed air line, and three pump lines. There is also a ladder in this fourth passageway that can

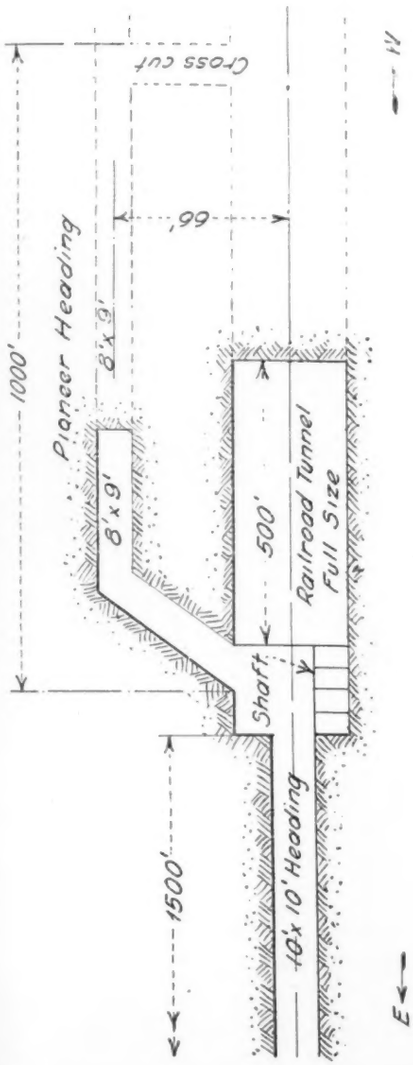


Top, left—Drum of the hoisting machine installed at Mill Creek.

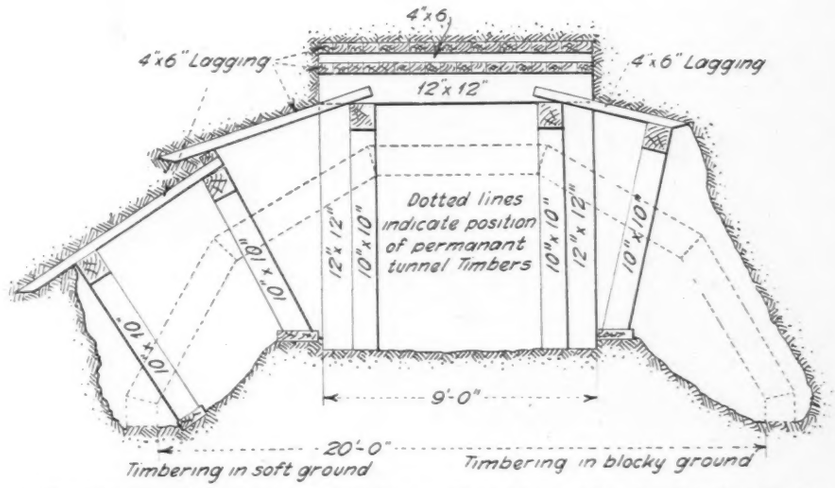
Top, right—First shovel of dirt dug in sinking the shaft at Mill Creek.

Bottom—Caterpillar tractor hauling a Diesel engine from the station at Berne to the Mill Creek powerhouse in the wintertime.

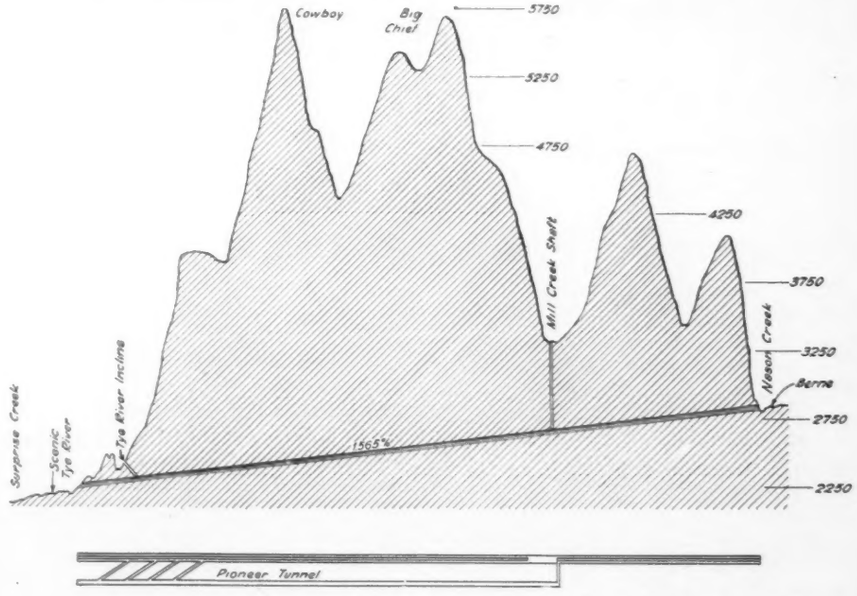




Plan of Mill Creek Shaft showing manner of advancing the 10x10-foot heading eastward and the pioneer and the main railroad tunnel westward from that point of departure.



Temporary and permanent timbering employed in driving top heading in the main railroad tunnel when advancing through either soft ground or blocky ground.



Vertical section and plan of the route of the new Cascade Tunnel on the line east from Scenic to Berne.

be used in case the man-hoist fails. Because they have to support their own weight, the water lines are of standard threaded pipes, while the joints of the air line are made with bolted flanged couplings.

Mill Creek Camp is located in an isolated valley, in the midst of virgin timber, about three miles away from the railroad station at Berne. Therefore, the transportation of supplies and essential materials of all sorts has constituted somewhat of a problem. The difficulties are, of course, intensified in the winter season, because very heavy snowfalls are normally to be expected. Accordingly, provision must be made to keep in store food enough to cover possible short periods of isolation which, however, would not exceed two or three days; and the same foresight must be exercised in providing for construction supplies. When the going is heavy on the road leading from Berne to Mill Creek Camp, hauling is done well-nigh entirely by two Holt tractors. Two Ford trucks are also used when the condition of the road permits. In places the grades over this road run as high as 15 per cent; and, while snow was still on the ground, the Diesel engines—which form the stand-by power plant—were dragged to the camp on log skids by the two tractors. Each engine represented a unit load of 23 tons.

Although both Mill Creek and the East Portal are supplied with current from the Great Northern Railway Company's Tumwater Powerhouse on the Wenatchee River, it was deemed advisable to establish at Mill Creek a stand-by plant composed of two 360-H.P. Diesel engines driving a like number of alternating-current generators. The capacity of this reserve plant is large enough to provide current for lighting, pumping, and ventilation both at Mill Creek and Berne in case of failure of the main transmission line. Up to date, the Tumwater hydro-electric station has been able to deliver current uninterruptedly to Berne and Mill Creek ever since the transmission line was extended to those points.

At the time the new Cascade Tunnel camps were visited by the writer, substantially 100 gallons of water a minute were being handled by the pumps provided for that purpose at Mill Creek. During the excavating of the shaft, the water encountered was disposed of by No. 6 and No. 9 Cameron sinkers. The system of ventilation is virtually identical with that employed in the West Portal—that is, 20-inch ventilating ducts, carrying air to the headings east and west of the shaft, and electrically driven fans are installed to furnish the needful circulation. At the bottom of the shaft, booster fans relay the air to the headings westward. These boosters are 5,000-foot fans. The main ventilating fan is at the surface, and delivers 10,000 feet of air a minute. As previously described in the case of work at the West Portal headings, the fans are reversed to withdraw air from the headings immediately after shooting. After that they resume their normal function of delivering fresh air to the headings.

At Mill Creek, work westward from the shaft consists of driving the main tunnel heading and a lateral 8x9-foot pioneer tunnel. Eastward from the shaft, the operation is limited to driving the 10x10-foot center heading of the railroad tunnel; and this procedure will continue until the 10x10-foot heading meets the 10x10-foot heading advancing westward from the East Portal.

The following tabular statement gives the progress made at the various headings of the new Cascade Tunnel during the months of November, December, and January of 1926 and 1927, respectively. The figures make it clear that the contractor is maintaining a high rate of progress:

	November	December	January
Scenic pioneer heading—East	952 ft.	819 ft.	844 ft.
Scenic center heading—East	942 "	892 "	1274 " *
Berne center heading—West	938 "	865 "	845 "
Mill Creek center heading—East	648 "	793 "	765 "
Mill Creek pioneer heading—West	620 "	745 "	752 "
Mill Creek full tunnel—West	200 "	219 "	244 "

*Drilling and mucking alternately in two different headings.

(To be Concluded)

EFFECTS OF STRESSES ON ARCH DAMS

EXTENSIVE tests upon the experimental arch dam at Stevenson Creek, Fresno County, Calif., referred to in a previous issue of this Magazine, have been finished, according to the present program of the United States Bureau of Standards working in coöperation with the Arch Dam Research Committee appointed by the Engineering Foundation. The dam is 60 feet high, and the upstream face, which is vertical, has a radius of 100 feet. From the crest down to a point 30 feet above the base the dam has a thickness of 2 feet, and from there downward the thickness is gradually increased to 7½ feet by a curved batter on the downstream face. All the tests were made at night so as to prevent temperature effects as far as possible.

Complete sets of deformation, strain, and slide measurements have been made for varying loads up to those produced by a head of 60 feet—the height of the crest of the dam. The only signs of failure, according to the Bureau of Standards, are two vertical cracks in the center line of the dam—one extending from the lowest point upward some 13 feet, the other from the highest point downward about 19 feet. The top crack opens widest at a head of from 45 to 50 feet; and at a head of 60 feet it returns practically to the same width as when no water is in the reservoir. This crack does not permit water to seep through. Its maximum width is about 0.03 inch. The lower crack is still smaller.

Cracks formed at the abutment between the dam and the foundation rock a short time after the completion of the dam, presumably because of shrinkage or temperature changes. These cracks were covered with a fillet of mortar in order to facilitate their observation. Very little change has occurred in them. The work of analyzing the data has advanced sufficiently to warrant the following conclusions:

The load carried due to the horizontal thrust in the horizontal elements, the arch ribs, has been determined for all parts of the dam under the 60-foot head. The load is at its maximum about mid-height and decreases to a small amount both at the top and the bottom of the dam.

The load carried by the bending of the horizontal elements has been approximately determined at certain places. The indication is that the greater part of the load lies nearer the vertical center line of the dam.

The load carried by the bending of the vertical elements has been partially determined. Evidently, near the bottom of the dam substantially all the load is carried in this manner. Near the top none of it seems to be so carried, and the vertical elements appear to be supported by the horizontal elements.

The advisability of increasing the height of the dam for the purpose of making further tests is now being considered by the engineers in charge.

NEW LEAD PAINT PROTECTS IRON AGAINST RUST

NEWS reports have it that a Swiss, Dr. A. V. Blom, has discovered a new lead paint that protects iron against rust. The paint is made, so it is said, by melting lead in an electric furnace and by blowing air and other reducing gases through it—thus producing a dross or scale consisting of very finely divided lead diffused in yellow lead oxide.

When powdered and mixed with a specially prepared linseed oil, minute particles of lead separate out and gradually penetrate the surface of the iron painted with it—the presence of the lead in the iron so coated having been proved by photomicrographs and by chemical analysis. It is claimed that iron covered with this pigment has shown no signs of rusting even after prolonged exposure or after being heated with steam. As rust is known to exact a toll of millions of dollars annually, a paint of this description should prove of great value.

According to the United States Trade Commissioner in Berlin, the German coal-liquefaction plant being erected on a site contiguous to the Leunawerke, at Merseburg, will embrace 23 large new buildings. This is significant, and indicative of the progress made in the art of extracting oil from coal.

Modern Power Plant in an Ancient Mining District

BY HENRI PACTAT

LINARES, in the Province of Jaen, Spain, is in the center of a lead-mining district that has long been a source of a superior grade of that metal. Lead mines there are said to have been worked as far back as the third century B. C., when that section of the country was dominated by the Carthaginians.

Linares is set among the southern foothills of the Sierra Morena, at an altitude of 1,375 feet above the sea. The town is a meeting point of four branch railroads which reach into the lead-silver district to the north and west; and Linares is directly linked by main lines with Madrid, Seville, Granada, and the principal ports on the south coast. The city's population—numbering 40-odd thousand—is chiefly engaged in working the mines and in operating industries that are identified in one way or another with the activities of mining, smelting, and fabricating the metals produced in the neighborhood.

Notwithstanding the antiquity of mining in the neighborhood, still the operators in the Linares district have generally had to obtain their mining equipment elsewhere—most of it, in fact, coming from abroad. This may be explained to some extent by the fact that British firms have been the ones most conspicuously engaged in this mining field.

Mr. Frank W. Cannaday, who has had a great deal of experience in mining in different parts of the world, a little while back took an option on a group of mining properties, near Linares, occupying a surface area of some 56 acres. These properties—now known as the San Traganton group—are made up of the San Traganton, La Plata, Santa Amalia, and Simpleza mines. For certain reasons, work at these mines was halted for seven or eight years, and during that interval they remained unpumped. The first problem, therefore, confronting the new owner was to find ways to unwater the mines; and this was made more difficult owing to the fact that there was a shortage of electric current in the district.

After a very careful study of all the existing conditions, Mr. Cannaday decided to install his own power plant and thus obtain all the current needful to operate the electric sinking pump he intended to employ in unwatering the properties. Accordingly, he asked for bids from the various manufacturers of Diesel engines. After due consideration of the different types of heavy-oil engines available, he awarded a contract to the Ingersoll-Rand Company to supply a 250-H. P. vertical, 3-cylinder engine, direct connected to a General Electric generator of 165 Kw. This contract was signed in January of the year gone; and at once Mr. Cannaday started work on the building and on the erection of a foundation for the unit. Twenty days after the arrival of the

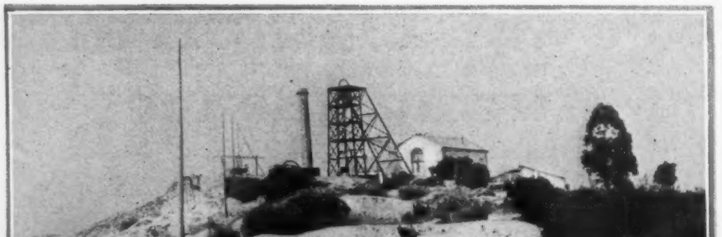
Top, left—Old plant at La Paquita Shaft, San Traganton. Right—A 40-mule team hauling to the lead mines parts of the I-R oil engine weighing 11 tons.
Bottom, left—Lowering a pump into one of the shafts. Right—La Plata Shaft of the San Traganton group of mines.

engine and the generator at the mine they were in position and furnishing current.

The pumping set consists of a vertical, centrifugal sinking pump direct connected to an electric motor. The pump is capable of raising 500 gallons a minute. Owing to the delayed arrival of the pumping set, unwatering was not begun till November 4, and from that date onward until December 20 the pump ran continuously—being shut down only at brief intervals when it was necessary to add lengths of piping to the pump discharge. The longest single nonstop run was for a period of 82 hours.

The oil engine has been installed with care, although there are no fancy touches to the enginehouse. Every essential detail has been looked after, and the result on the whole is a layout that appeals especially to the practical mining engineer. The building is of stone and is commodious enough to house two 250-H. P. oil engines and the main air compressors. Air for operating the "Jackhamers," the "Leyner" sharpener, etc., used in connection with mining work, is supplied by a 100-H. P. Ingersoll-Rand compressor.

This power plant has been visited by some of the most important mining men of the district; and each and all of them have been particularly impressed by the simple starting arrangement of the engine and by the means provided for quickly opening up the crank case when it is necessary to adjust the bearings. Thus, the newest type of prime mover is furnishing power for operating mines that have been yielding lead and silver for more than 2,000 years.



Magdalena Shaft of the lead mines.

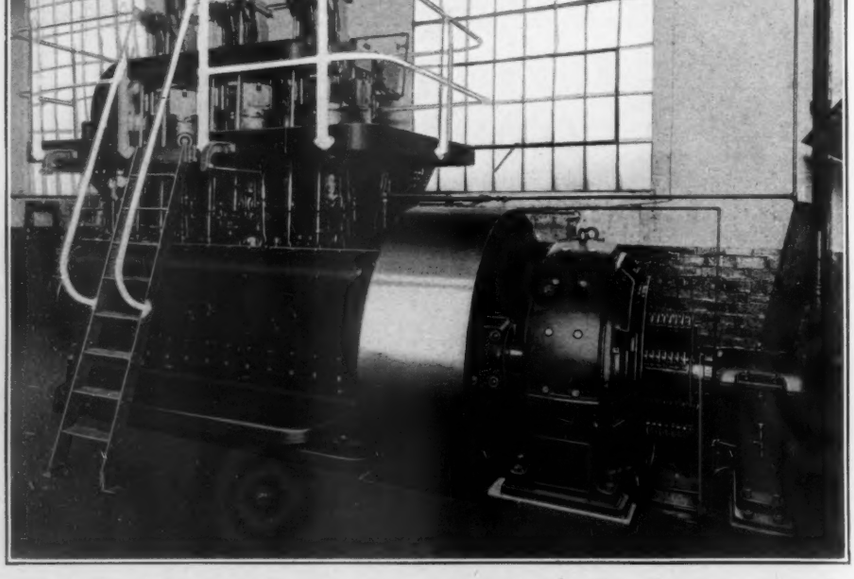
SILICON STEEL

THE development of cheaper alloy steels is the purpose of certain investigations being conducted by the United States Bureau of Standards. The substitution of silicon, in part or in whole, for the more expensive metallic alloys now in use in this country has been suggested, following a study of the German-made silicon steels recently introduced in Europe for structural purposes.

Except for the fact that it has a slightly higher carbon content, the German steel differs but little from similar steels known 40 years ago. Silicon steel has been used in America for a number of years. It was manufactured somewhere around 1910 by a domestic plant for the United States Navy; and the *Mauretania* contains such steel made in England two decades ago.

The reason for the increased strength of the new German steel seems to lie in its low carbon content. It is declared that as long as the percentage of carbon is kept below .15, the addition of 1 per cent. of silicon—a cheap alloying element—gives a steel having properties approaching those of a steel containing 3 per cent. of nickel, which is a rather expensive alloy.

The American Society for Testing Materials has recognized the usefulness of silicon as an alloying element and has drawn up tentative specifications for silicon structural steel. The prevailing American practice is to use a medium carbon steel and to employ both silicon and manganese as alloying ingredients. Inasmuch as silicon steel holds forth the dual promise of high quality and low price, it may expect to receive increasing attention from American manufacturers.



Type of Ingersoll-Rand oil engine that furnishes power at the San Traganton group of lead mines in Spain.

EXPOSITION SHOWS NEW HAVEN'S PROGRESS

THE City of New Haven, Conn., recently took stock of its resources in the form of a rather notable exposition. This Progress Exposition, so called, was in effect a cross section of the various phases of endeavor of the town's inhabitants, offered in the form of exhibits.

It went beyond the scope of the ordinary industrial exposition. In addition to showing products of the local factories, the business, educational, and civic aspects of New Haven were put on exhibition. Such institutions and organizations as the schools, Yale University, the city government, the community chest, and the various public utilities, presented information of their activities through an arrangement of charts, models, and working displays.

The success of the venture was beyond all forecasts. When the sponsoring agency, the New Haven Chamber of Commerce, had completed the great amount of labor incident to the assembling of the exposition, that body was somewhat apprehensive—fearing that the public interest might not justify the effort expended.

The most sanguine hopes were exceeded, however, when 250,000 persons viewed the exposition during the ten days it was conducted. This total was 70,000 more than the estimated 1926 population of New Haven, showing the large attendance of people from out of town. The exposition also was a source of surprise to New Haven's citizenry generally. It revealed local resources and activities beyond their conception.

The cost of staging the exposition reached $60,000, while the aggregate value of the displays was $4,000,000. In the light of the foregoing, New Haven voted the venture well worth while.

Just three decades ago there were four "horseless carriages" in the United States. Today more than 15,000,000 passenger cars and 1,900,000 trucks are registered.

Spray Painting Saves Time and Money

In Many Instances Compressed Air is Superior to the Bristle Brush in Applying Paint

By C. H. VIVIAN

THE construction of the numerous buildings required for the Chicago Exhibition in 1893 proved so great a task that the opening was delayed a full year. Even then, some of the preparations had to be hurried. As the available time grew shorter and shorter, it became evident that some means would have to be found to speed up the painting.

While officials were discussing possible courses, one of the men in charge of the fire-fighting station that had been provided on the grounds ventured the opinion that a painting machine might, perhaps, be improvised by rigging up one of the fire engines. The suggestion was acted upon; and, so the story goes, proved not only practical but brought about a material saving in the cost of the remaining work. As far as we know, this is the first recorded instance where paint was applied to building structures on a large scale by means other than a brush.

Extensions to air brushes make possible the painting of ceilings and higher portions of walls without the need of erecting scaffolding.

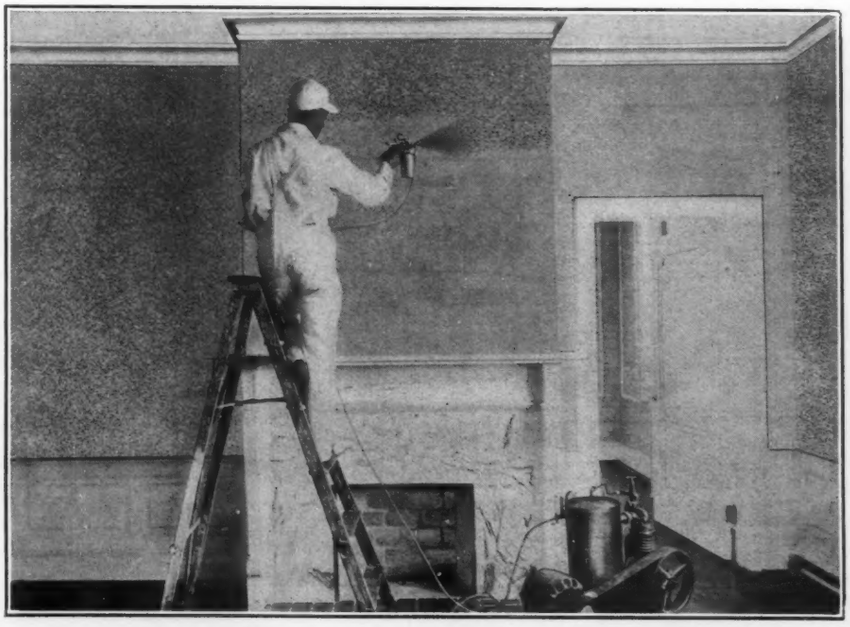
Soon thereafter, the expedient born of necessity was seized upon and modified until there was developed a more or less accepted method of blowing paint upon surfaces with a jet of compressed air. Large corporations, given to scrutinizing maintenance costs with keen eyes, were the first to approve and to adopt this simplified method. The Pennsylvania Railroad, for example, has been using compressed air for the painting of some of its rolling stock since 1899; and, together with other principal railroads of the country, has found that its employment results in efficiency and economy.

If you fall in that broad class which is loosely defined as the "average citizen," you no doubt pause now and then while perusing your favorite magazine to note the pleasing blend of colors or the expressive play of light and shadows in its illustrations. Likely as not, the artistic touches which make them alluring to the eye were imparted to the original photograph or drawing by a miniature air brush in the skillful hands of the retoucher who prepared the picture for the engraver.

In this case, a tiny stream of compressed air carries the pigments and their vehicle through a nozzle so small that a needle is used for a shut-off valve stem. The equipment will operate under a pressure of 30 pounds to the square inch, or it may be throttled down to a delicate, almost imperceptible spray whose action and effect may be likened to the soft blowing of one's breath into a thin film of mist upon a windowpane.

Again, you may marvel at the realistic tints upon the faces of some of the ingeniously created dolls that grace the American nursery of today. Dexterous handling of the air brush is responsible therefor, as was detailed in a recent issue of Compressed Air Magazine. By way of contrast to this delicate work there is the application of heavy, metal base paints to structural exteriors with air under a pressure of 85 pounds and higher. Between these extremes is a wide range of uses, each calling for a variation in equipment, in pressure, and in technique, but all operating on the same principle.

This principle involves more than the mere propulsion of paint with air under pressure. Within the typical spray brush or "gun," the paint, varnish, or whatever it may be, is brought in contact with compressed air which is introduced in such a manner as to atomize or to break up the material into fine particles. The air stream, carrying the finely divided material in suspension, then escapes through a nozzle and expands into a spray as the pressure is released. Controls are provided for both the paint and the compressed air, and various effects can be attained by regulating the proportions in which they enter the atomization chamber.

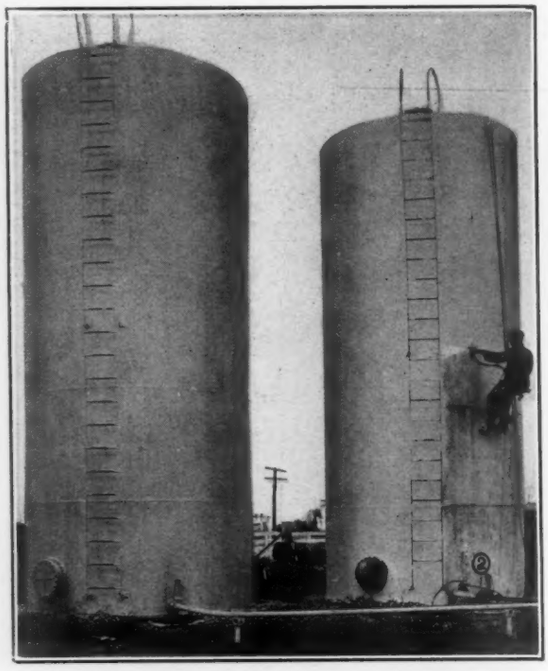


Color misting an interior. The stippling is applied over a solid-color base. By repeating the process with different colors variegated effects can be produced.

Figures are lacking as to the portion of the nation's painting that is done by air brush. No one connected with the paint industry will attempt to estimate it. Suffice it to say that spraying now extends to virtually every branch of the painting industry, where the bristle brush once held undisputed sway. In addition, new fields of service all its own have been discovered for the paint spray that now coats everything from celluloid buttons to motor cars, from bird cages to dynamos. A qualified spokesman for the paint industry declares that 25 per cent. of the paint now made in this country is re-

quired for manufactured products. Most of these products are painted by air brush, though in the case of some assembled articles, the individual parts are dipped before being brought together to form the completed unit.

Mechanical or spray painting signalizes a distinct advance in the direction of economy. In a sense, it is to the paint industry what the linotype is to the printing world. As it saves time, labor, and money, spray painting tends to conserve property by encouraging the more frequent application of paint. This is a matter of more importance than might appear at first glance. The investment in standing property in the United States is placed at $101,000,000,000. Only one-fourth of this property is now protected by paint. Every year the unpainted 75 per cent. deteriorates 2 per cent. more than does the painted 25 per cent. This "neglect tax," as it has been termed, amounts to the impressive sum of $1,-500,000,000 annually. Neglect of this nature constitutes a great foe of material wealth, being three times as destructive as fire. Rust, alone, is charged with a property toll of $600,000,000 each twelvemonth.



The air brush gives the painter a wide "sweep" in painting tanks or similar objects calling for the use of tackle.

To cite a definite authority, the American Appraisal Company has determined that property that is painted every fifth year depreciates 40 per cent. of its cost value over a 50-year period, while unpainted property depreciates 85 per cent. in 20 years. In other words, the regular protection of exposed surfaces with paint increases their period of usefulness more than five times. However, though the need for more painting is obvious, the man-power with which to do it by the older method is not available. There are, according to authoritative reports, 10,000 fewer journeyman painters in the United States than there were a few years ago. The depletion of their ranks is attributed to the fact that the trade of painting is not conducive to steady employment.

Fortunately, the greatest saving effected by the air brush is in the labor factor involved. One man can do the work that formerly required from two to five men, depending upon the nature of the job. On some classes of work conservation of material is also realized. Likewise, because of the greater thickness of film that can be obtained when paint is applied with air, it is possible at times to eliminate one coat of paint.

Coincident with the development of spray painting, there has come into being the science of paint engineering. Specific paints are now available for various purposes, and exhaustive research is rapidly adding to the knowledge concerning the proper preparation of surfaces to be painted, the proper materials to be used, and the most effective means of applying them.

It is significant to note in this connection that the air brush often not only reduces the cost of the work but actually does a better job. For example, experience has taught the paint engineer that paint applied with a bristle brush contains innumerable minute depressions or "valleys." Though usually invisible to the eye, these are in reality low lanes. Careful observation has shown that the paint wears through first along these valleys. The air brush, in the hands of a trained operator, produces a smooth film of uniform thickness throughout that outlasts one applied with the brush.

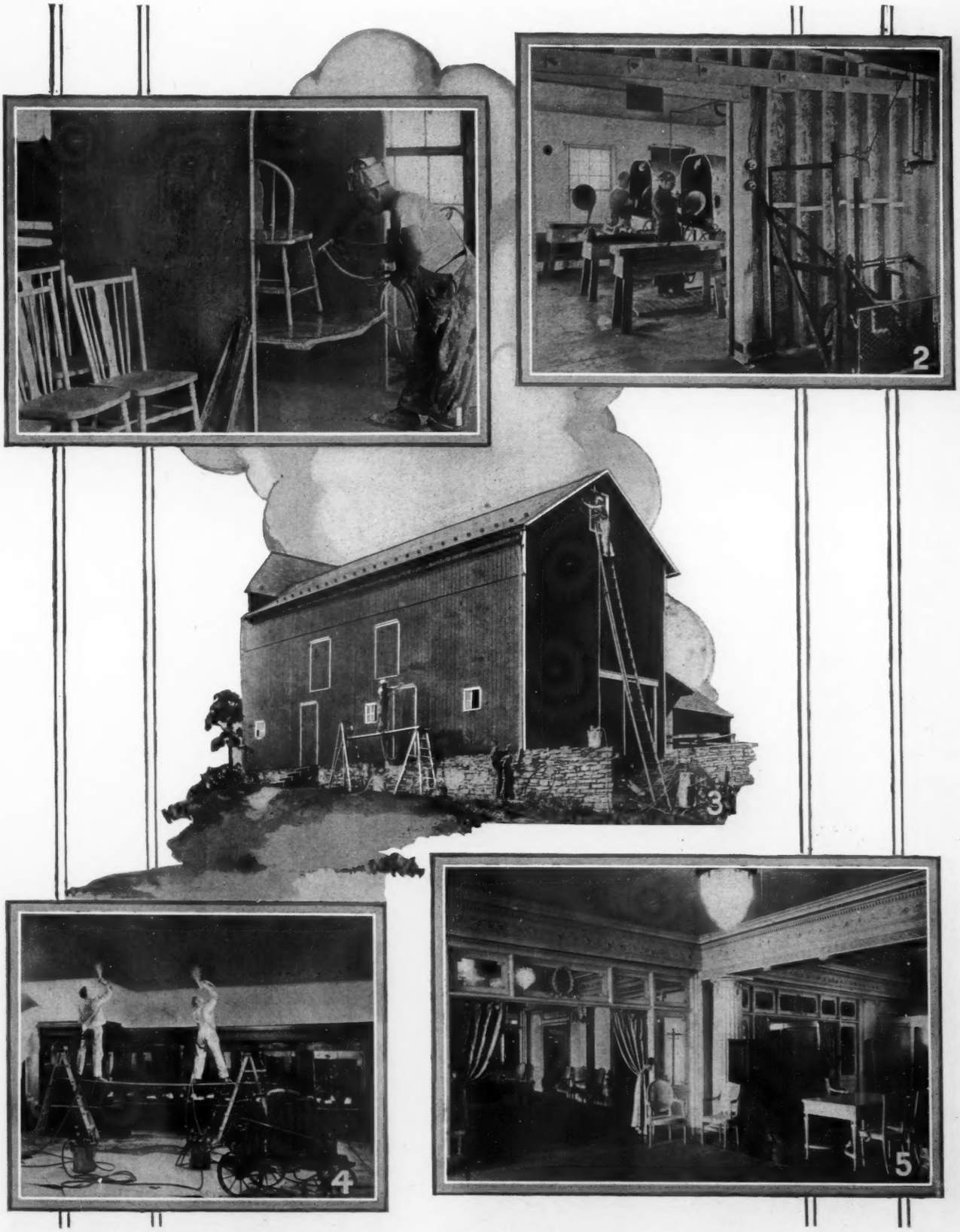
The time element is an important one on many paint jobs, and the air brush has proved its worth as a time saver. Many industrial plants cannot afford to suspend operations for the prolonged periods required for bristle-brush painting. The air brush reduces the duration of the enforced shutdown to a minimum. For that matter, it is not uncommon now to do painting while plants are in full operation. Extensions, purposely provided for the paint spray, enable painters to reach ceilings and the high portions of walls without the need of scaffolding.

Spray painting is especially applicable to structures having broken lines; and the time-saving factor looms large on this class of work. Uneven surfaces like concrete, rough brick, and stucco, are extremely difficult to paint with bristle brushes but easy to coat with the paint spray. In fact, experience has shown that the wear and tear on brushes makes the cost of this sort of painting almost prohibitive. Moreover, it is next to impossible to completely cover such surfaces.

Notable advancement has been made in recent years in adapting the air brush to fine interior work. Mottled finishes known as stipple work, formerly the result of hand labor, can now be done quickly with compressed air. This is achieved by reducing the air pressure or by thickening the paint, or both. In stippling, the paint is not so finely divided in the nozzle and comes out in globules which are distributed unevenly upon the surface. By going over the surface several times and by using a different color each time it is possible to obtain an attractive variegated finish.

The air brush plays an important part in the maintenance of passenger, mail, and baggage coaches.

Almost all household furniture, even to pianos, radio sets, and the like, are finished with the air brush. Enamels, lacquers, varnishes, and other special finishes can all be applied to advantage by the spray method. While the design of the apparatus utilized has some bearing on the matter, the general rule is to regulate the air pressure according to the specific gravity and the viscosity of the material used. Aluminum paints and lacquers can be sprayed at pressures ranging from 15 to 20 pounds to the square inch, while white



1—A close-up of the painting, with compressed air, of breakfast-room furniture. In an 8-hour day, one workman can coat 50 tables and 200 chairs.
2—Applying Japan finish to radio loud speakers in a commercial japanning plant in Newark, N. J. The hoods are fitted with exhaust fans for drawing off the fumes.
3—Portable air-spray outfits are effective anywhere in quickly and economically painting all kinds of structures.
4—The air spray lends itself as well to interior as to exterior work. Here we see a fashionable shop in New York City being "done over."
5—Section of a Fifth Avenue shop, New York City, in which all the painting was done by means of the portable outfit illustrated in picture No. 4.

Paint impelled by means of air reaches points inaccessible to the bristle brush. This picture shows the painting of an intricate assemblage of tubing.

lead calls for pressures of from 40 to 85 pounds to the square inch.

Where a large painting contract is to be done, it is generally more economical to employ a single large compressor capable of delivering air for numerous brushes. For small jobs, portable apparatus embodying all the essential parts are commonly used. Truck-mounted outfits make it possible to paint farm buildings and other isolated structures with compressed air.

The automobile industry is among the largest users of spray painting. By this method the Ford factories have cut in half the time formerly required for finishing bodies, fenders, and hoods. Pyroxylin, a nitrated solution of cotton, is the material utilized to impart the final touch. It has been found in the Ford plants that where successive coats are applied a superior finish is secured by varying the direction of the "stroke."

When the industrial history of the World War is written, it will contain at least one interesting mention of the part played by spray painting. Some of the shells employed by the Allies were loaded with picric acid. If allowed to come in contact with the metal this fluid would have formed picrate of iron, a substance very sensitive to shock. To prevent this, the interiors of the shells were coated with a very tough varnish. As the ammunition was being turned out on a quantity-production basis, the varnish was applied by the air-spray method to insure the complete protection of the metal.

The air brush has lightened the painter's labors considerably. Assuming that the man handling a bristle brush dips it into the paint once a minute, he bends over some 500 times in the course of an 8-hour day The newer method eliminates this back-breaking movement as well as the wrist-fatiguing stroke by which he puts on the paint.

Numerous comparisons of the bristle brush and the air brush have been made to show the time, labor, and material involved in each case. These comparisons serve to place spray painting in a decidedly favorable light. A few years ago, the Pennsylvania Railroad announced that it was saving 60 per cent. on labor costs by spray painting. In other words, two men were doing the work that had formerly called for the services of five. The National Paint, Oil & Varnish Association, Inc., has compiled some illuminating figures relative to the two methods. The following information is taken from Report No. 18 of the association:

Painting Oil Tanks

	Surface Area Sq. Ft.	Paint Used Gals.	Time Hrs.
Hand brush....	67,641	124.25	413.0
Air brush.....	67,641	82.60	20.5

Comparative Costs

	Paint	Labor	Cost 100 sq. ft.
Hand brush...	$372.75	$413.00	$1.16
Air brush.....	247.80	20.50	.40

Painting Brick Walls and Cornices

	Surface Area Sq. Ft.	Paint Used Gals.	Time Hrs.
Hand brush....	8,188	9.87	41
Air brush.....	8,364	10.80	20

Comparative Costs

	Paint	Labor	Cost 100 sq. ft.
Hand brush...	$39.48	$36.90	$0.93
Air brush.....	43.20	18.co	.73

One of the largest paint jobs ever attempted by spraying is now underway in New York City in connection with the Holland Vehicular Tunnel under the Hudson River. The inner surfaces of the tubes, representing approximately 1,109,000 square feet, are receiving three coats of paint. Another large piece of work in which air brushes played a conspicuous part was the painting of the sets used in making the motion picture *Ben Hur*. It is reported that 58,000 gallons of paint were used for that purpose.

Examples of the successful use of spray painting for classes of work that could be accomplished only with difficulty, if at all, by the bristle brush, are common in large industrial plants. Engineers at a large New Jersey establishment were recently faced with the problem of painting various groups of intri-

An illustration of the use of the air spray in giving dolls "that healthy look."

Newspapers serve to protect portions of an automobile that are not to be painted. An experienced air-brush operator can go over the body of a car with surprising speed.

cately assembled iron tubing. Because of their arrangement and their close spacing, which can be seen in one of the accompanying photographs, portions of the tubes were so inaccessible as to render it virtually impossible to paint them by hand. With air brushes, however, the paint was blown between the tubes and deflected in such a manner as to insure the complete coating of all surfaces.

This particular piece of work was done under contract by the Sprayon Painters, Inc., of Newark, N. J. The paint—consisting of a primer coat of brown, a coat of dark grey and a finishing coat of light grey—was applied by air brushes of the Eclipse make. The air supply came from the stationary compressor plant of the establishment. This plant consists of two XRE type machines, direct connected to 100-H.P. synchronous motors. As a permanent line distributes the air to various parts of the property, it was necessary only to connect with this system at a point convenient to the transformers. The air brushes were operated at a pressure of 45 pounds.

A typical instance of the use of spray painting for the preservation and the finishing of manufactured products was observed at the Crystal Japanning Company's plant at Newark, N. J. This establishment is equipped to enamel the general run of small metal parts and commodities. By applying the enamel with air at low pressure and by heat treating the articles before drying, an especially attractive finish is obtained. The general appearance of this finish is that of overlapping scales or flakes having a high luster. It is known in the trade as crystal finish, and is popular on various articles ranging from radio-cabinet panels to match stands. It is made by subjecting the freshly-painted metal to an oven heat of 350° F., for periods of from 1½ to 3 hours.

The painting is done in hoods open on one side only and provided with exhaust fans to draw off all fumes. The air is furnished by a class ER-1, single-stage, double-acting, straight-line compressor belt driven from a countershaft. It supplies sufficient air to operate seven brushes.

FORTY-THREE YEARS OF PUBLIC SERVICE

THE Coeur d'Alene Hardware & Foundry Company of Wallace, Idaho, recently added a new building to its salesrooms. The opening of this addition marked another milestone in the progress of this old and estimable firm whose growth has paralleled the development of mining in the famous ore-producing region in which is its home.

The largest mercantile establishment in the Coeur d'Alene, this concern is the outgrowth of a business that had its inception in 1884, when J. H. Marks and W. W. Hart forsook placer diggings for commercial pursuits. From its original frame buildings, having an aggregate floor space of 5,000 square feet, the firm has expanded to the point where it now utilizes 140,000 square feet in thoroughly modern structures. In the meantime, its roll of employees has increased from 7 to 140.

The company designs and builds certain mining machinery, and acts as selling agent for several well-known lines. It also does a general supply business. Ellis L. Hale has been manager of the organization since 1918. Other officers are: Jerome J. Day, president; Harry L. Day, vice-president; James F. McCarthy, treasurer; and L. C. Wilson, assistant manager.

IT PAYS TO WASH RAGS AND WASTE

AN example in conservation has been set by H. E. Aldrich, master mechanic of the Reading Transit Company, Reading, Pa., that might be followed with profit by other establishments that require large amounts of rags and waste for cleaning purposes.

Because of the very nature of the materials, they have usually been disposed of rather carelessly with the result that, in the plant in question, rags and waste represented a big item in the annual shop budget. This set Mr. Aldrich to thinking; and the outcome is a washer that makes it possible to reclaim what was heretofore considered a total loss.

The soiled rags and waste are now deposited in a galvanized iron tank where they are thoroughly boiled in an Oakite solution—compressed air being used to agitate the mass while undergoing treatment. After they are dried, the clean cloths and waste are returned to the stockroom for re-use.

The present personnel and shop of the Coeur d'Alene Hardware & Foundry Company of Wallace, Idaho. The company started business in a modest way more than twoscore years ago.

Flying Boat Plays Part in Rouyn Copper-Gold District

By THE STAFF

ROUYN—the Town of Rouyn—lies in the Province of Quebec, Canada, and in the heart of an intensely mineralized district that gives promise of yielding amazing quantities of copper and gold. This assumption is based upon exploratory work of an exceptionally thorough and scientific character. Rock drilling done systematically and over wide areas has established with reasonable accuracy the existence of unusually large mineral bodies of outstanding richness.

This aerial map of the Rouyn gold fields was made from photographs taken from the flying boats operated by the Fairchild Aerial Transport Limited.

Rouyn has sprung from the wilderness in the course of the last three years through the outcome of the restless quest of the mineral prospector. Rapidly, and from the most modest of beginnings, Rouyn has attained the sizable proportions of a community of about 1,000 inhabitants, and with this growth it has acquired many of the hallmarks of a well-organized mining town. This development has been effected despite the handicaps of a remote and rugged region, exposed in the wintertime to deep and driving snows and to the sweep of bitter winds that carry the mercury of the thermometer to points well below zero.

Not until last October could Rouyn be reached by rail; and access to the district was possible only by following circuitous and devious land and water routes. For instance, the journey from Haileybury—lying 70 miles to the south, as the bee flies—entailed a 16-hour trip by motor car and canoe. Because of this, many needful things were denied the town until the railroad was finished; and certain essential materials were transported to Rouyn at a well-nigh prohibitive cost—much of the hauling being done in the wintertime over snow-covered land and across frozen bodies of water surfaced with ice 4 feet thick.

Rouyn's isolation over this developmental period would have been far harder to bear had aerial transportation not made it possible to cover quickly during the open months the distance between Haileybury and Rouyn. In other words, flying machines made in an hour a trip that would have taken 16 times as long by the other available means of transit.

The relief offered by air route has been due to the enterprise of the Fairchild Air Transport Limited, which instituted and maintained regular service between Haileybury and Rouyn. The type of machine used has been of the Aeromarine all-metal hull model, capable of carrying 5 passengers and 600 pounds of freight. The following account of an air trip, made last June from Haileybury to Rouyn, was written by an appreciative passenger:

"Leaving Haileybury at 11 a. m. with passengers and freight, we headed slightly east of north, gaining height all the time until, fifteen minutes later, at 4,000 feet the pilot swung east following a narrow watercourse known as River des Quinze and striking a lake of the same name. This we followed north, leaving the town of Angliers, which is at the railhead of the Canadian Pacific Railway, immediately behind us. This is the last sign of habitation until the smoke from the overnight town of Rouyn is seen lying due north on our course. At 11.30 we were passing over Lake Barriere, and quickly followed in succession Lake Evain, and the River Kekeko. At 11.50 the pilot throttled down into a long glide, making for Rouyn dead ahead, where, at twelve noon, we completed our journey—having covered the 70 miles from Haileybury in just one hour.

"Rouyn, to be best described, is nothing more or less than a scene from Service's book, 'The Trail of '98.' Log cabins, countless dogs, streets full of stumps and not a sign of anything but miners and prospectors. It lacks the noisy saloon owing to the Quebec liquor law, but dance halls, etc., are there in full swing. Our plane was met by the usual interested crowd, and mail, freight, and passengers were quickly unloaded. The freight, of some 600 pounds, consisted of a wide variety of things—ice cream, lemons, oranges, lettuce, celery, strawberries, etc., and was eagerly snatched up at high prices in just 30 minutes after landing. Strawberries, for instance, selling at 75 cents a box, seemed to be the most sought after fruit.

"A stroll through the village of 1,000 people and one comes, on the outskirts, to the Noranda Mine—the pulsing heart of this mushroom town. Noranda has ore blocked out to the tune of $45,000,000 in copper, with gold deposits sufficient to pay for cost of production."

At the start, this welcome air service was looked upon as merely a stop-gap until the railroad reached Rouyn, coming south from O'Brien on the Canadian National Railways. But this use of the flying boat is to continue; and, according to the present plans of the Fairchild Aerial Transport Limited, a number of additional flying boats is now in course of construction. And these craft will be used intensively upon several routes that are to penetrate this great mining region and do their part in helping to open up the territory and to keep the people concerned in touch with the established communities to the south.

One of the sturdy flying boats that have done such excellent service in maintaining rapid intercourse in the Rouyn copper-gold district.

Photos, courtesy Fairchild Aerial Surveys of Canada, Ltd.

Photographs taken from the Aeromarine boat of the Fairchild Aerial Transport Limited.
1—Expansive vista of the Rouyn copper-gold district.
2—Nearing the Town of Rouyn.
3—Noranda Mine near the Town of Rouyn.
4—Here we see how Rouyn is growing and developing a Main Street.
5—The thriving community of Haileybury 70 miles south of the Town of Rouyn. It is between Haileybury and Rouyn that the Aeromarine boat has formed an important link in rapid communication.

Mining In British Columbia

The Province Has Already Yielded Much Mineral Wealth and Promises to be a Still Heavier Producer

By RUPERT W. HAGGEN*

BRITISH COLUMBIA mining activities have recently attracted wide attention for three reasons: first, a record in mineral production in 1926, estimated to have a value of more than $70,000,000, that exceeds the output of any of the other northwestern provinces of Canada; second, a spectacular rise on the market of the stock of the Consolidated Mining & Smelting Company of Canada, Ltd., the largest operator in the province; and third, the assurance of increased future production resulting from the opening up of new properties and the expansion of established mines.

British Columbia, a province 387,000 square miles in area, owes to the gold seeker its influx of population. The first placer finds on the Fraser River, in 1855, were the signal for a rush of prospectors from California, of whom the more hardy penetrated the interior wilds. Cariboo, which yielded $50,000,000 of placer gold in a few years, was discovered; and fields were opened up in Big Bend and Cassiar. By 1875 the gold-bearing gravel beds were largely depleted, and mining dwindled to an inconspicuous industry. Its revival dates from the discoveries of lode minerals in the "nineties."

A noteworthy feature of British Columbia's mining industry is its diversity of mineral products and their widespread geographical distribution. Besides the Sullivan and other silver-lead mines, the southwestern portion of the province contains vast beds of coking coal that are worked by the Crows Nest Pass Coal Company. Farther west is the old Rossland Camp, from which 5,000,000 tons of ore has been taken. South of that is the camp of Ymir, now making a good showing. North of Rossland, in the Slocan-Ainsworth District, we find the old Boundary Camp where the Granby and the British Columbia Copper companies formerly operated large mines and smelters.

At Beaverdell, just beyond the old Boundary Camp, lies Wallace Mountain with a number of "poor men's mines." The two most noted properties there are the Bell and the Sally mines. High-grade silver-lead ore, carrying values of from $200 to $500 per ton, is shipped direct to the smelter. In addition to financing developments, the profits have provided competencies to the owners. West of Wallace Mountain, at Similkameen, are the Nickel Plate Mine—which has paid over $4,000,000 in dividends—and the Granby Company's Copper Mountain property, which is a large producer.

Twenty-five miles by sea from Vancouver is the Britannia Mine, owned by a subsidiary of the Howe Sound Company. A production of 3,000 tons daily is maintained there—the ore containing copper, gold, and silver. An effective development program by its engineers has made it a profitable mine, which carries evidences of a tremendous ore reserve. On Vancouver Island are collieries that have produced steadily since 1852 and that now employ 3,000 men.

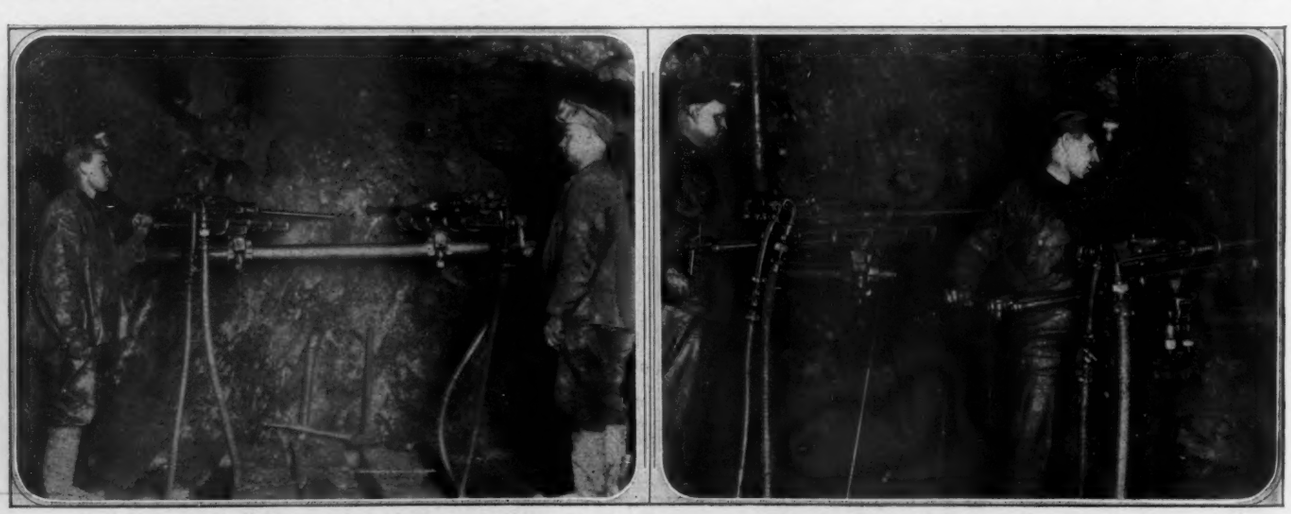
In the central section of British Columbia there are a number of gold, silver, copper, lead, and zinc showings. While none is at present being worked on a large scale, the region will undoubtedly develop some important mines before many years. On the northern coast there are two big mines: the Granby Company's Hidden Creek and the Premier, in the Portland Canal District. The Granby has its own smelter at Anyox. The Premier came into production only in 1920; but since 1921 has distributed to its shareholders annual dividends aggregating $1,600,000. It produces some high-grade gold-silver ores, but the main ore body returns about $22 per ton. The Guggenheim organization is interested in this property.

A number of mines in the Portland Canal and Alice Arm districts have shown up well under development. Several of them are making small but steady shipments; and there is every reason to believe that the next few years will see important additions to the list of producers operating in those localities. In the Atlin District, in the extreme northwest of the province, an old placer camp is now yielding lode gold.

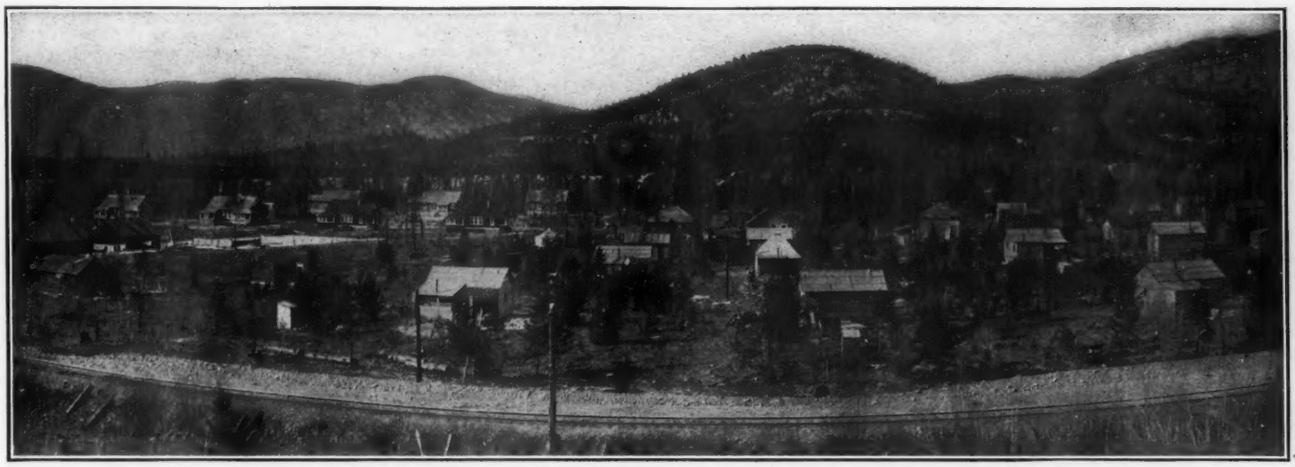
Numerous islands just off the coast give a protected waterway, it being necessary to go into the open Pacific at only three short stretches between Vancouver and Skagway; and various gulfs and streams extending inland to the coastal range make possible economical freighting by barges for long distances.

The outstanding mine of the province—the Sullivan of the Consolidated Mining & Smelting Company of Canada, Ltd.—is situated at Kimberley, 19 miles from Cranbrook, a divisional point on the Crowsnest Pass branch of the Canadian Pacific Railway. The Sullivan was discovered in 1892 by Pat Sullivan, John Cleaver, and Ed Smith, prospectors from the Coeur d'Alene country. They drove a 90-foot tunnel, using for the purpose hand drills and sledges—not to mention muscle—for they had no air compressors. During the first few years about all that was done was the $100 worth of assessment work required on each claim annually for five years, or until a certificate of improvement is granted. With the coming of rail transportation in 1899, syste-

Manager, Mines Publishing Company, Ltd.



"Leyner" R-72 drifters at work in the Sullivan Mine at Kimberley, B. C.



Chapman Camp at the Sullivan concentrator of the "Consolidated."

matic development was started. The first ore shipments were made in 1900. During the three following years some 4,000 or 5,000 tons of 35 to 40 per cent. lead ore, carrying about 15 ounces of silver, was shipped to smelting works at Nelson and Trail.

A total of 300,000 tons of ore had been opened up by this time, when it was decided to erect a smelter at Marysville, seven miles from the mine. Despite serious metallurgical problems this plant treated 75,000 tons of ore; but it was closed down in 1907 because careless sorting of ore at the mine made it impossible to treat the lead content profitably.

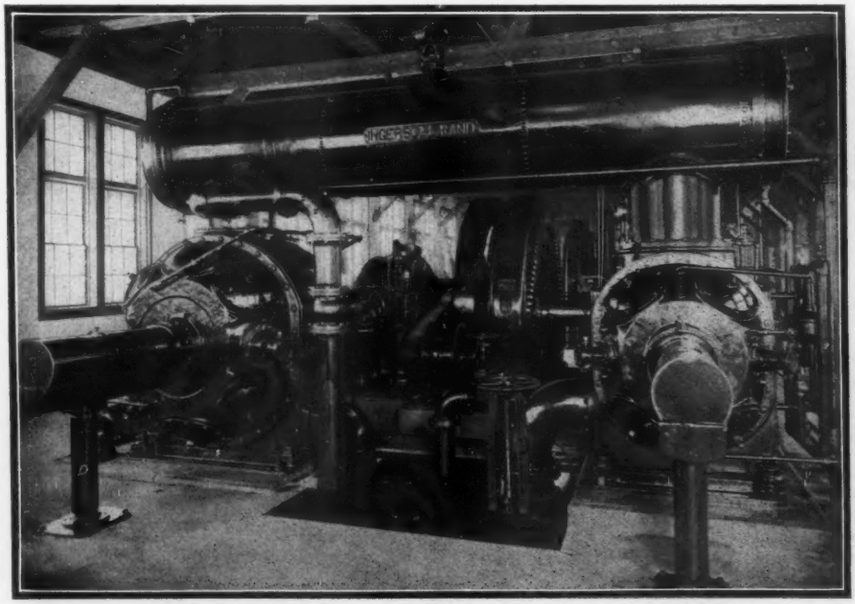
A reorganization was effected in 1909 by the bondholders and creditors, control being vested in the Federal Mining & Smelting Company. The "Consolidated" company began working the property under a bond and lease in December, 1909, and immediately took steps to improve the grade of ore mined and to increase the sorting facilities. Underground development and diamond drilling revealed ore bodies which induced the Consolidated officials to exercise stock options; and in 1910 the ownership passed into their hands. To the three original claims—the Hamlet, Shylock, and Hope—considerable adjoining territory was added, the mineral claims now held covering an area of 9,400 acres. For the first few years, operations were aimed toward the exploiting of ore sufficiently high in lead and silver and sufficiently low in zinc to be smelted with the equipment available at Trail.

Annual shipments for 1910 to 1915, inclusive, ranged from 23,000 tons to 44,650 tons. In 1914 the mine became the largest lead producer in Canada, a distinction it has since retained; and in 1925 it was the largest single producer of lead and zinc in the world. Total output up to October, 1926, was 4,970,000 tons, of which 4,800,000 tons came from the stopes and 170,000 tons from development openings. At the present time, 1,100,000 tons are being mined annually, the metal yield being about 200,000 pounds of lead, 110,000 pounds of zinc, and 4,000,000 ounces of silver. The ore also includes tin, iron, sulphur, bismuth, and cadmium. The daily output amounts to 9 tons for each man employed underground.

The ore bodies occur as replacement deposits in argillaceous quartzites of the Aldridge formation of the pre-Cambrian sedimentary-rock system. The typical ore, as developed, is a mixture of galena, zincblende, pyrite, and pyrrhotite. In places, lenses of each of these individual minerals occur as high-grade ores. The lead-zinc ore occupies two zones, known as the south and the north ore bodies. Between them is a zone of about 800 feet where the ore consists of iron sulphides. The ore bodies have an average dip to the east of 23 degrees, though local changes in both dip and strike result from folding and at times complicate mining. The ore bodies attain a maximum thickness of 240 feet at right angles to the dip.

The mine is operated from two tunnels whose portals are 3,900 and 4,600 feet above sea level. The lower tunnel is the more important one, and is a 10x12-foot drift driven in the footwall quartzite to its junction with the ore at the north zone. It has been advanced 11,500 feet from the portal. The 4,600-foot tunnel is a 6x9-foot drift. From these two tunnels numerous suitable openings into the ore bodies, as well as connections between the two levels, have been made to facilitate mining operations.

The room-and-pillar method of mining is being followed. About 15 per cent. of the ore has been left in pillars, which, to insure adequate support as greater depth is reached, will probably be increased to hold 25 per cent. The plan for future development calls for pillars 100 feet square, the distance between centers to be 300 feet. These pillars will ultimately be mined.



Big compressor of Type "PRE-2" in service at the Sullivan Mine, Kimberley, B. C.

Large quantities of compressed air are used in the Sullivan operations. The compressor plant has a capacity of 14,000 cubic feet, 6,000 cubic feet of which is supplied by a PRE-2 machine. These machines are driven by electric energy, except during three months of the year when a 3,000-cubic-foot compressor derives power from a water pipe line. There is also a stand-by steam-driven compressor plant which can deliver 3,000 cubic feet of air if occasion demands. A 6-inch air line serves the

upper tunnel, while 8-inch and 10-inch mains supply the lower tunnel.

One-man type water "Leyner" drills are utilized in all workings. "Jackhamers" are employed for plugging. More than 100 drills are run. The 1¼-inch hollow, round steels used are reconditioned on "Leyner" sharpeners. Sixteen holes are usually drilled in an 8x10-foot drift, and from 10 to 12 holes in a 6x8-foot drift. Eighteen holes are common in raises and in starting or advancing a stope.

Air-operated shovels and shovel loaders have proved effective in handling large tonnages at low costs. Dragline scrapers of 3-, 3½-, and 5-foot widths are also utilized in places. The two larger sizes are run by Ingersoll-Rand double-drum hoists, 6x7 inches and 8¼x10 inches, respectively.

The main tunnel carries a 36-inch-gage track with 6-ton and 12-ton, 250-volt trolley locomotives. Running in tandem, the 12-ton motors haul about 175 tons of ore on each trip, while storage-battery locomotives gather trips from the drift faces not accessible to trolley lines. Smaller equipment is used in the upper tunnel, where the track is of 18-inch gage.

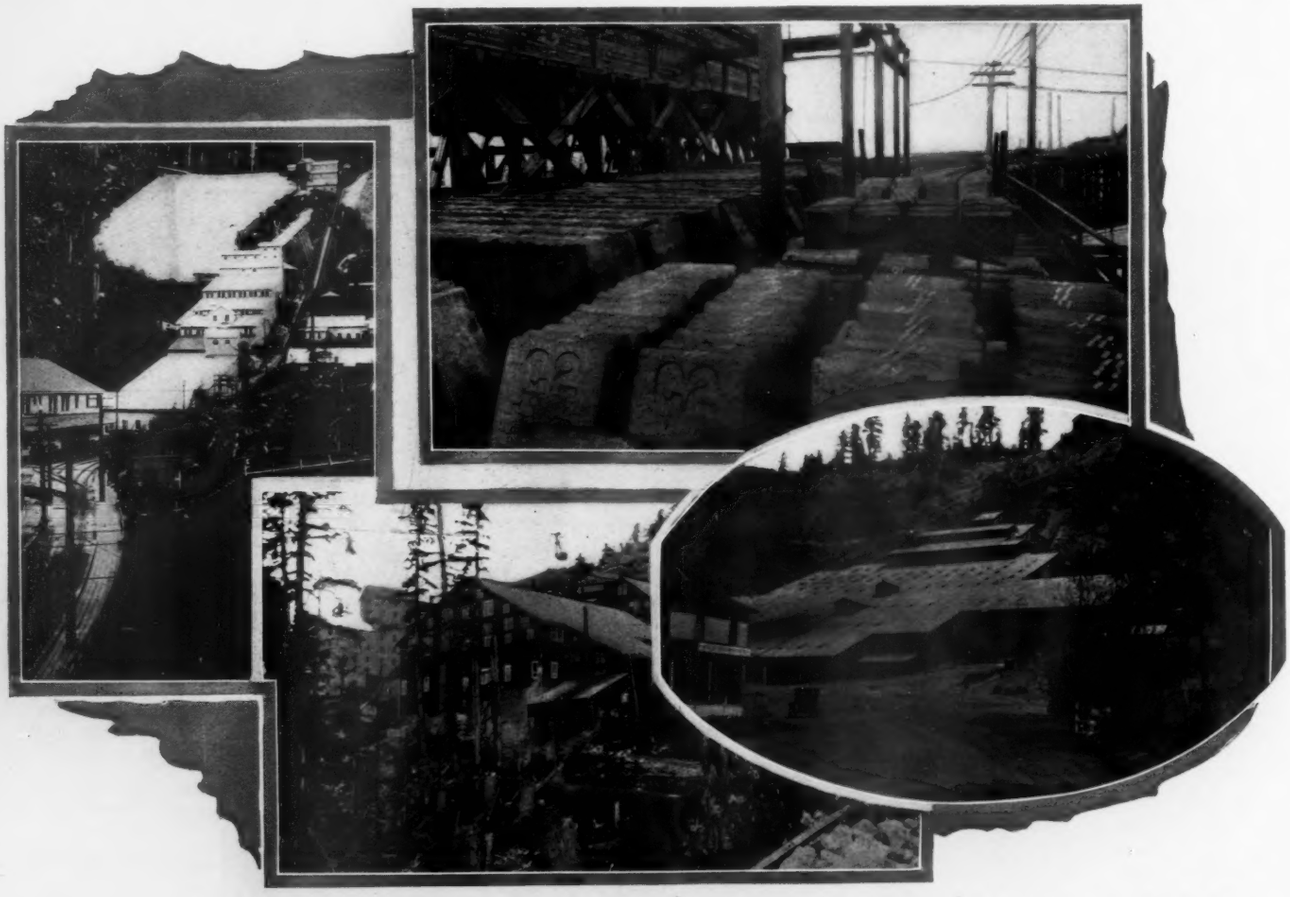
The tunnels are lighted by electricity. Ventilation is natural, except in long drifts where blowers are provided. A private telephone line connects the surface with the stations in the north and the south ore bodies. All trains are dispatched by telephone. McDougall townsite, near the main tunnel portal, includes a well-equipped hospital and about 90 houses for employees. Once a month a committee of workmen meets the management to discuss matters of mutual interest.

The Consolidated has an organized mining branch that is working several properties besides the Sullivan Mine; that is doing prospecting; and that is carrying out programs looking toward the development of other holdings in various parts of Canada. On one of these prospects, an 8x6-inch Type Twenty portable compressor is used to operate a drifter at an altitude of about 8,000 feet.

There are only two smelters in British Columbia: the Granby Company's plant, at Anyox, and the plant, at Trail, operated by Consolidated. The original smelter, at Trail, was built in 1895 by the F. A. Heinze interests to handle the ores of Rossland. The spot is well chosen, lying on a bench overlooking the Columbia River and 18 miles south of the Arrow Lakes. Railroads offer connections with the territory lying to the north, south, east, and west.

As first designed, the smelter was to handle gold-copper ores. After a few years the plant passed into the hands of the Canadian Pacific Railway, being operated as a side line by that concern. At that time an extension was made to handle the silver-lead ore of Slocan, which had previously been sent to American smelters for treatment. The Kootenay ores, however, carry silver, lead, and zinc. Owing to the presence of the last-named metal, the ore is complex and, for a while, proved a nightmare to the metallurgists at the smelter. Instead of paying for the zinc content of that ore, the producer was actually penalized because of it. There were smelters which would pay well for zinc ores and concentrates; but the combination of lead and zinc was fatal. The zinc content of the ore would "freeze" the lead furnaces and, under certain circumstances, put them out of commission.

In 1906, the Trail smelter and the War Eagle, Center Star, and St. Eugene mines were consolidated under the name of the Consolidated Mining & Smelting Company of Canada, Ltd. At the beginning of the World War, when the zinc supply was found to be very largely in control of German interests, the Allies were confronted with the problem of discovering a new source of this necessary metal. The price of zinc had soared to 48 cents a pound. In the meantime, and as a result of experimental work conducted by F. W. Guernsey, the staff of the Consolidated

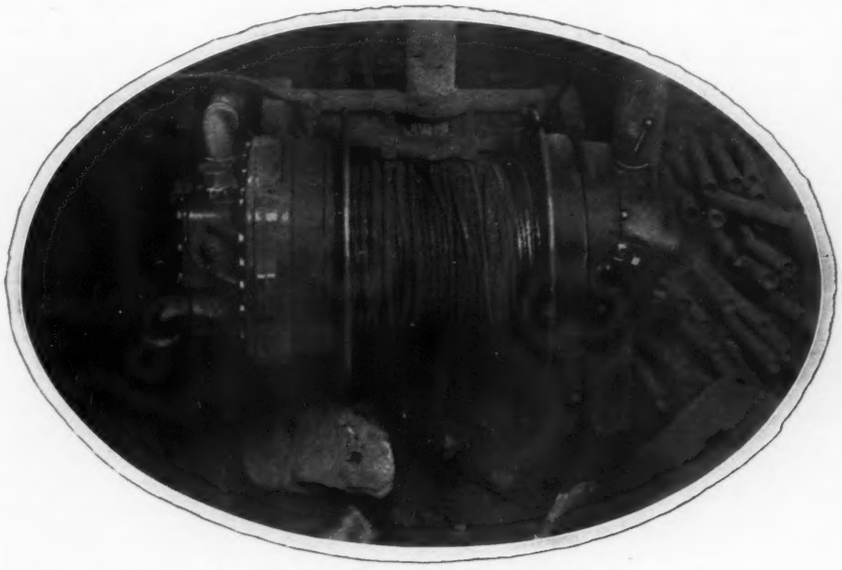


Courtesy, British Columbia Bureau of Mines.

Top, left—Surf Inlet Mine and Mill, on Princess Royal Island, are important producers in British Columbia. Right—Copper ingots ready for shipment from the Granby's smelter at Anyox.
Bottom, left—Concentrator at the Premier Mine where high gold-silver values are recovered. Right—Mill of the Hedley Gold Mines, Ltd. The Hedley is one of the most promising of the smaller producing mines.

produced zinc by an electrochemical process. The Imperial Munitions Board at once saw their opportunity to obtain zinc from the ores of British Columbia, and entered into a contract with the Consolidated for zinc at 15 cents a pound.

During 1916, a total of 6,000 tons of zinc was produced at Trail. From that time on improvements were made in the process; and the plant was enlarged until, in 1925, production reached 49,000 tons. As the present smelter was completed only in July of 1925, it is estimated that the 1926 output will be a much greater one.



A "Little Tugger" hoist used for slushing in the Sullivan Mine of the "Consolidated."

The research work and the development of the zinc process cost the Consolidated more than $3,000,000; but today the company is in a position to place "Tadanac" zinc in the world's markets at a cost that can compete with that of zinc produced anywhere. "Tadanac" is the brand of zinc produced by the Consolidated, and it has won world-wide recognition because of its excellence. The introduction of differential oil flotation has enabled separate lead and zinc concentrates to be made at the mill. This has simplified the final process of refining, besides making it possible to save freight costs.

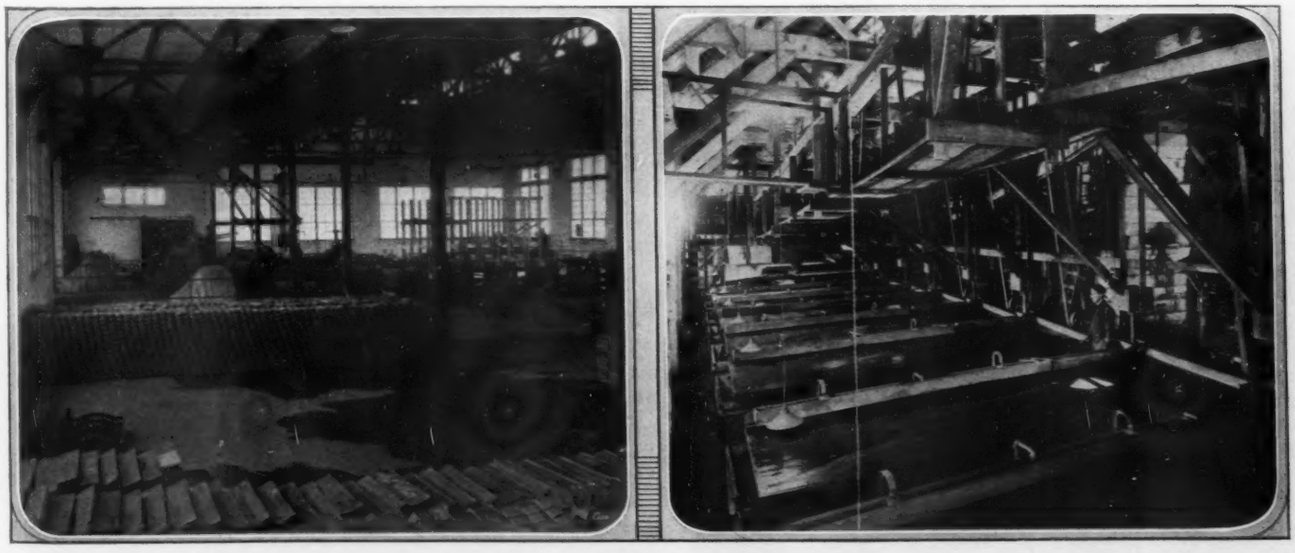
As it stands today, the smelter at Trail covers 250 acres of ground and gives employment to 1,600 men. It includes a 70-ton copper refinery, with melting and casting equipment; a copper-rod mill; and up-to-date machine shops in which most of the machinery used in the plant has been made from designs by the staff. The company manufactures its own acids at Trail. Sulphuric acid, utilized for the leaching of the zinc content before electrolytic deposition, is made from pyrite from the Sullivan Mine, while hydrofluoric acid, for electrolyte in the lead tanks, is obtained from fluorspar taken from the Consolidated's quarries. The metals produced commercially are gold, silver, copper, lead, and zinc; but experimental extraction has been made of chemically pure iron, tin, cadmium, and antimony.

During 1925, the company handled 1,210,698 tons of ore, which yielded 20,516 ounces of gold, 4,704,635 ounces of silver, 366,439 pounds of copper, 118,000 tons of lead, and 49,000 tons of zinc. The low copper production was due to the fact that the plant was running only during the last three months of the year, following resumption of operations at the Granby Company's mine at Copper Mountain. The value of the sales in 1925 totaled $28,562,065.66.

In experiments conducted at the plant with pyrrhotite, the Eustis process was employed and iron was deposited electrolytically at the cathode. No commercial use has as yet been made of this discovery, which is of considerable importance in that it might tend to pave the way for producing a steel of higher grade than is now made. Some manufacturers believe that the presence of oxygen and hydrogen in iron, as turned out by present methods, is responsible for a lack of purity in the product. Higher-grade steel would prove of great value in the manufacture of automobile and airplane parts.

The discovery of tin in the ore coming from the Sullivan Mine is a recent one. Cassiterite, containing 70 per cent. tin, is being extracted from that ore, and it is reasonably certain that this will be refined at an early date, or when the best method of treating it has been devised. The Consolidated has made no statement on the subject; but rumor has it that 2 tons of cassiterite are obtained daily from the 4,000 tons of ore mined. Cassiterite is a by-product. For the further utilization of waste products from the Sullivan Mine it is planned to put the sulphur content of the ore to commercial account in conjunction with phosphates—recently discovered in beds in East Kootenay—by producing fertilizers.

Among the subsidiaries of the Consolidated, is the West Kootenay Power & Light Company, Ltd., which has its plant at Bonnington Falls, on the Kootenay River, 30 miles from Trail. It supplies cheap power not only for mining and smelting operations but also to adjacent towns and to the country westward



Left—Part of the copper-rod mill of the "Consolidated" at Tadanac.
Right—Tables in the concentrator at Tadanac.

as far as Copper Mountain, 320 miles distant by rail but less by power line. The station is ideally located, operating under a 70-foot head.

Generally speaking, there is a steady growth in the mining industry of British Columbia. There is no boom, but a great deal of new work is underway. It is a very healthy state of affairs. Much more might be written on the subject and more space devoted to the success attending the operations of other large companies—such as the Granby, Howe Sound, Premier, Hedley, etc., all very important factors in an industry that is attracting increasing attention yearly.

SAND BLAST USED TO CLEAN SIGNAL LENSES

THE use of the sand blast instead of water in cleaning signal lenses is apparently a novel application of compressed air, but that is how the work has been done for a year and more at the Union Station Terminal Yards, Chicago, Ill. The signals in question are of the ground type—the so-called "dwarf" or "jack" signals, each of which has three hooded lenses.

Washing the signals with water was not at all satisfactory. It was almost impossible to get them thoroughly clean in this way; and in the wintertime the water often froze on the surfaces. As it is quite important that the lenses should be clean at all times to perform their warning functions, someone conceived the idea of trying out the sand blast for this work. Our informant has not revealed who this someone is; but the method has proved entirely satisfactory and has furthermore greatly cut down the amount of labor needed.

The sand blast used is a home-made contrivance, and consists of a ¾-inch pipe, 4 feet long, with a wye joint at one end, of a 3-foot length of hose leading from one arm of the wye into a pail of sand, and of a ¼-inch piece of pipe connected with the air line and entering the other arm of the wye so as to project into the ¾-inch pipe several inches.

By means of this improvised sand-blast equipment it is possible for two men to clean the large number of signals in the Union Station Terminal Yards in a few hours, just four seconds being required to thoroughly clean a lense. To prevent the blast of sand from removing the paint from the metal hoods there are fitted into them, before the air is applied, cup-shaped pieces of tin. This is merely one more way of using compressed air in this busy terminal yard where it helps to lighten labor in many directions. Air for these multiple purposes is furnished by two 550-foot steam-driven compressors.

The value of the cargo passing through the Port of New York is now twice as great as that passing through the Port of London. This is partly due to the fact that New York City is the largest manufacturing center in the world.

About 5,000,000,000 cans of preserved foodstuffs are consumed annually in the United States.

FERTILIZERS, THEIR SOURCES, MANUFACTURE, AND USES, by Herbert Cave. An illustrated book of 116 pages, published by Isaac Pitman & Sons, New York City. Price, $1.00.

THIS book has been designed especially to appeal to the general and the commercial reader; and the writer has succeeded in presenting this interesting subject in a non-technical way. As we are told at the very start: "The question of the fertility of the soil is one of increasing importance, for it is by the soil, directly and indirectly, that man lives. The population of the world is constantly expanding. . . . It has long been recognized that the fertility of the soil can be increased by the addition of certain substances." The author shows how these substances contribute to the promotion of plant life and how they can be obtained.

SHIP MODEL MAKING, by Capt. E. Armitage McCann. An illustrated book of 150 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $2.50.

THIS book is the second of two volumes having to do with different applications of the same constructive principles and practices. It deals especially with the making of a model of an American clipper ship. Ship models have become something of a fad; and lads and those of maturer years find much pleasure, if not profit, in the fabrication of small craft of this sort. The present book will serve as a sure guide to anyone intent upon constructing a miniature of a type of vessel that once added much renown to the American merchant marine.

TRANSACTIONS OF THE INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND. An illustrated volume of 834 pages, published by The Institution, Glasgow, Scotland.

THE present volume, the sixty-ninth, contains the usual wealth of valuable engineering information, and it is significant that much attention is given to the consideration of internal-combustion engines and to the commercial application of fuel oil. Among the other topics presented are those having to do with increased efficiency in steam application for marine purposes; the failure of metals by creep; the possible future developments in Atlantic express passenger services; the design of high-speed motor boats; and the economic value of bunker coal.

VENTILATION AND HEALTH, by Dr. Thomas D. Wood and Ethel M. Hendriksen. An illustrated work of 210 pages, published by D. Appleton & Company, New York City. Price, $2.00.

DESPITE the fact that fresh air has been vital to the welfare of the human race ever since man evolved upon this globe of ours, still the science of ventilation has only lately passed beyond the speculative stage. Theories, and many of them, have been advanced from time to time, but most of these have rested upon inconclusive or incomplete experiments. Recently, however, very important research work has been carried on that has revealed positive data of the highest value in the realm of ventilation; and the authors of the present volume have presented this information in an understandable and an attractive manner. An ample supply of fresh air is of importance to all of us, and this book can be read to advantage by everyone.

Port Handbook of New Orleans. This valuable illustrated brochure was issued by the Board of Commissioners of the Port of New Orleans under date of December 1926. The brochure describes the maritime facilities now at the disposal of shipping in the Port of New Orleans; and reveals how successful have proved those splendid undertakings, the Inner Harbor and the Navigation Canal, which were called into being at great expense by the enterprising citizens of "The City that Care Forgot."

Raymond Automatic Pulverizers is the title of a booklet recently issued by the Raymond Brothers Impact Pulverizer Company, Chicago, Ill. This catalogue deals with modern grinding and pulverizing with air separation.

Airco Davis-Bournonville Oxygen Manifolds is the title of a catalogue recently issued by the Air Reduction Sales Company, New York City.

Midwest Air Filters, Inc., Bradford, Pa., has recently issued detail sheets of its air filters and of methods of installing Type B air filters. These pamphlets should be of interest to anyone contemplating fitting air filters to compressors and engines.

The following new publications have been announced by the United States Bureau of Mines, and can be obtained by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.:

TECHNICAL PAPER 390. Occurrence, Distribution, and Significance of Alkali Cyanides in the Iron Blast Furnace, by S. P. Kinney and E. W. Guernsey. 1926. 37 pp. 12 figs. 10 cents.

TECHNICAL PAPER 396. Low-Temperature Carbonization of Coal, by A. C. Fieldner. 1926. 46 pp. 26 figs. 15 cents.

Petroleum in 1924, by G. B. Richardson and A. B. Coons. 1926. 74 pp. 4 figs. 15 cents.

Antimony in 1925, by J. W. Furness. 1926. 9 pp. 1 fig. 5 cents.

Arsenic in 1925, by V. C. Heikes. 1926. 4 pp. 5 cents.

Asphalt in 1925, by G. R. Hopkins and A. B. Coons. 1926. 9 pp. 5 cents.

Bauxite and Aluminum in 1925, by James M. Hill. 1926. 13 pp. 5 cents.

Feldspar in 1925, by Jefferson Middleton. 1926. 8 pp. 5 cents.

Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1925, by J. P. Dunlop. 1926. 6 pp. 5 cents.

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—*Founded* 1896—

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EDITORIALS

COAL MAY YET GIVE US MOTOR FUELS

JUST once so often some one expresses concern about the future of our petroleum supply, and pictures at the same time how we shall be handicapped when our oil wells cease to yield.

To those persons, commonly alarmed by such agitation, we urge that they read a report issued a few weeks ago by the United States Bureau of Mines and entitled, *Low-Temperature Carbonization of Coal.* That technical paper shows how farseeing the Government's experts are and, incidentally, discloses how processes have already been developed that will make it possible for us to obtain from native coals an abundance of motor fuel and other oils when our petroleum-bearing fields cease to be productive.

The author, Mr. A. C. FIELDNER, reports:

"Some time in the near future, when petroleum becomes scarce, an ideal combination process of carbonization may be developed which will provide the necessary substitutes for oil and gasoline. In this ideal process the full yield of primary oils will be extracted from the coal by carbonizing at gradually increasing temperatures to remove all the volatile matter from the coke. Then the coke will be converted by way of the water-gas reaction to carbon monoxide and hydrogen which, when heated under high pressures (100 to 200 atmospheres) in steel autoclaves in the presence of suitable catalysts, may be converted into alcohols suitable for motor fuel. DOCTOR FISHER, of the Institute for Coal Research at Muelheim-Ruhr, has succeeded in making such a mixture of alcohols ranging from methanol to an alcohol containing 9 carbon atoms. This mixture, which he terms 'synthol,' was made at 150 atmospheres pressure and 400° C. by use of a catalyst composed of iron oxide impregnated with alkali. The fuel gave satisfactory service in a motor-cycle engine. Methanol is now made in Germany by a similar process in copper-lined autoclaves, with zinc oxide as catalyst, at a manufacturing cost of 18 cents a gallon.

"The Bergius process recently developed in Germany for converting coal into oil also offers great possibilities for the treatment of western bituminous and sub-bituminous coal. In this process, as used at Mannheim, pulverized coal, mixed with oil or tar to form a thick paste, is heated at 400° to 450° C. in a steel autoclave under a pressure of 150 to 200 atmospheres of hydrogen. Under these conditions the coal is converted into a black, tarry liquid which, on distillation up to 300° C., yields oils and tar to the extent of 30 to 60 per cent. of the weight of the coal. The by-products are ammonia and gas.

"This process can most certainly provide us in the future with ample quantities of substitutes for the products we now get from petroleum. Our reserves of coal are ample for many years. The time when such a process can be profitably worked will be determined by the exhaustion of our present abundant supply of petroleum. No one can predict the date. It may come before we expect it."

MINING CHILEAN NITRATE BY NEW METHODS

HERETOFORE, most of the nitrate mining in Chile has been done by hand methods. A new system of mining *caliche* has been devised by American experts in combination with improved processes for the subsequent extraction of the nitrate at the mill. This is not only good news for Chile, who draws so large a part of her annual revenue from the exploitation of her nitrate fields, but good news also to farmers generally who must depend upon fertilizers to enrich the earth in order to reap abundant and profitable crops. Reasonably low-priced fertilizers is a matter of vital concern to these tillers of the soil.

We are authoritatively informed that, by the hand methods widely prevailing in mining *caliche*, anywhere from 15 to 25 per cent. of the nitrate-bearing material is left on the ground, and from the remainder that reaches the plant for treatment an average of not more than 65 per cent. of the nitrate is recovered for marketing. Furthermore, so it is said, *caliche* containing less than 14 per cent. of nitrate cannot be mined by hand and made to yield a profit.

With the new mining methods and the new process of treating the *caliche*, it is now commercially practicable to work deposits containing as low as 6 per cent. of nitrate and to extract 90 per cent. of the nitrate in the raw material. These technical developments promise to effect revolutionary changes in the Chilean nitrate industry and, at the same time, to make it possible for the industry to compete effectually with nitrates manufactured by some of the advanced processes used in the fixation of atmospheric nitrogen.

CONTINENTAL DIVIDE HOLED THROUGH

THE 18th of February will long be memorable in Colorado, because on the eve of that day PRESIDENT COOLIDGE, in Washington, pressed the key that released the spark that detonated the charges of dynamite that broke through the final barrier of rock between the east and the west headings of the water tunnel of the Moffat Tunnel—thus piercing the Continental Divide on a line 6.09 miles long from end to end. Such is the present climax of an undertaking that will make real DAVE MOFFAT's dream—something that he thought to bring about over a period of many years and in behalf of which he gave of his best in both a material and a spiritual sense.

MOFFAT was intent upon building a railroad that should link Denver with Salt Lake City by tunneling the Continental Divide so as to place Denver in the advantageous position of a city directly located on a transcontinental route. It is a matter of stirring railroad history how, failing to obtain the great sum of money needful to drive a tunnel through the Rockies, he constructed his road so that it could mount by a devious and steep climb to the crest of Rollins Pass at an altitude of 11,660 feet. To pull a freight train of 22 cars up that 4 per cent. grade has called for the strenuous efforts of 4 big steam locomotives. The 90-mile run, including this climb, has generally taken from 14 to 16 hours even when unhampered by snow which often attains a depth of many feet in a short while. Despite these physical handicaps, monetary difficulties, and other operating drawbacks, the Denver & Salt Lake Railroad has continued to render service—essential service—to a section of Colorado of vast potentialities.

Finally the people of Colorado, still inspired by DAVE MOFFAT's dream, banded together, called into being the necessary agencies, and began the driving of the Moffat Tunnel at the west portal of the line in September of 1923. Similar work was started at the east portal during the October following. Based upon the prophecies of competent geologists it was believed that both the water tunnel or pioneer tunnel and the associate main railroad tunnel could be completed within 3 years and 10 months. Unfortunately the geologists could not see into the bowels of the mountain and discover that Nature had interposed soft or rotten rock where sound rock was counted upon, nor foretell that water veins would be opened up from which subterranean floods would pour at times. These impediments or unexpected developments have unavoidably slowed up progress; but, notwithstanding these hampering conditions, the work has gone forward wonderfully well. This progress has been due in the main to the exercise of a high order of engineering skill, to the use of the latest and best of rock drills and tunneling apparatus of one sort or

another, and to the contractor's unfaltering determination to forge onward even in the face of staggering difficulties.

The holing through of the water tunnel will make it just that much easier to hasten the work of removing the mile of rock that now intervenes between the two approaching headings in the main railroad tunnel. Unless the unexpected happens and difficulties of an even more trying nature than those already met are encountered there is ample warrant for the belief that the railroad tunnel will be finally holed through before the year ends.

This great task would undoubtedly have been deferred still longer had the engineering experts been forewarned of the conditions with which they would have to do battle; and the progress achieved is just one more splendid example of what can be expected when tunnel engineers and competent contractors are face to face with a job that they have pledged themselves to finish.

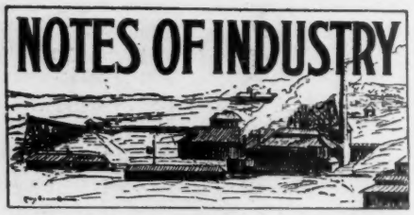
The completion of the Moffat Tunnel will give a new lease of life, a new impetus to greater service to the Denver & Salt Lake Railroad and it will also provide a shorter route east and west for a number of other railroads that must now make long detours either north or south in getting around or over the Continental Divide when bound to and from the Pacific Coast. Finally, Denver will reap a full measure of the benefits resulting from her changed position as a city situated on direct routes linking her with both the Atlantic and the Pacific coasts.

ENGINEERING SOCIETY HAS ANNUAL BANQUET

THE Engineers Society of Northeastern Pennsylvania held its 30th annual banquet at the Hotel Casey, Scranton, Pa., on January 20, past. As usual, it was a very enjoyable affair and was largely attended. Those immediately responsible for the success of the banquet were the following members of the organization: P. G. Rimmer, general chairman; William Wilhelm, speakers committee; William Lloyd, reception committee; E. P. Dietrick, decoration committee; E. J. Mulvihill, dinner committee; and L. A. Hamilton, ticket committee.

Mr. S. D. Dimmick was toastmaster. Speeches were made by C. R. Seem, president 1926; R. H. Buchanan, president 1927; and by Judge Harold B. Wells, of New Jersey. The address of the evening was made by W. L. Abbott, retiring president A. S. M. E., Chicago, Ill.

The best method of combating the decay of mine timbers is to treat them with a good preservative before placing them underground. Observations made by the United States Forest Service, which coöperated with the United States Bureau of Mines in a study of this subject, have brought out that treated timbers placed in a Pennsylvania coal mine 18 years ago are still practically all sound. Untreated timbers, on the other hand, last only a few years.



Compressed and liquefied gases to the aggregate value of $56,404,723 were manufactured in the United States in 1925—an increase of 3.6 per cent. over the 1923 output.

The great topographic map of the United States is less than half completed despite the fact that the work has been in progress for a generation. When finished and assembled into one sheet, the map will cover considerably more than an acre of ground.

How much scientific metallurgy is responsible for improved conditions in mining is shown by the records of one of the big western mines. Where the Utah Copper Company used to recover 60 per cent. of the copper in its 1.3 per cent. ore, and handled 24,000 tons a day, it now recovers 90 per cent. from poorer ore and handles 40,000 tons daily.

The Philippine Islands include 7,083 islands and rocks having a land area of some 114,400 square miles. It is interesting to note that of the total land area 94 per cent. is represented by but eleven of the group.

Statistics compiled by the National Safety Council reveal that ten lives are lost in the United States every hour through accidents that should not take a toll of more than one life in that period.

The Ruhr iron and steel district, extending from western Germany into Belgium, Luxemburg, and including Lorraine, is the world's second largest producing area for this mineral and its products. The United States is in the lead with 10,500,000,000 tons of ore, of about 50 per cent. iron content, out of a total world reserve of 57,000,000,000 tons.

South America, with an area over twice that of the United States and with a population of some 65,000,000 people, produces about 260,000,000 bushels of wheat, or less than one-third of the average wheat crop of the United States.

In wealth per capita, Canada is surpassed only by Great Britain and the United States.

More than 500,000 bales of cotton are used annually in the United States in the manufacture of tire fabric.

The Automobile Club of Italy, in collaboration with the Ministry of Public Works, is planning to reconstruct 12,000 miles of that country's roadways.

Canada leads the world in the production of newsprint with an output last year of 1,882,000 tons, or an increase of 24 per cent. over the preceding twelvemonth. The United States is second in importance—her mills having turned out 1,687,000 tons in 1926.

The per capita diamond wealth of the United States is approximately $40, the largest of any country in the world. More than 10,000,000 carats, having a total value of $4,000,000,000, are now owned by Americans.

What is said to be the world's largest ventilating fan was installed not long ago in a South African coal mine. The fan, which is driven by a 650-H.P. motor, delivers 700,000 cubic feet of air per minute.

A new pig iron, known as "Lilleby No. 1," is being manufactured in Norway, according to *The Engineer*. The new material is said to contain an exceptionally high percentage of certain alloys, such as vanadium and titanium, which improve the physical properties of the resultant steel out of all proportion to the amount of the alloys present. The analysis of the iron is as follows: vanadium, 0.5 minimum or 0.6 minimum; titanium, 0.5; silicon, 0.8 to 1.2; sulphur, 0.001 to 0.003; phosphorus, 0.07; manganese, 0.1 to 0.2; and aluminum, 0.1 to 0.2 per cent.

The last annual report presented by the British Electricity Commissioners reveals that Great Britain's production and employment of electricity are on the increase. In the period 1922-1923 the sales of electricity per capita averaged 88 kilowatt-hours, as against 117 kilowatt-hours in 1924-1925.

In a new type of electric safety lamp for miners, displayed in Vienna, the filament is made up of a series of semi-circular loops of palladium, and the bulb is sealed with a disk or porous stone. The base fits the standard lamp socket. When the atmosphere is normal, the ends of the filament are dark red; but when methane gas—the deadly fire damp—is present in the air, the center of the filament becomes brilliantly incandescent. With 8 per cent. or more of methane gas present, the center of the filament continues to glow even after the current is turned off.

Among its many activities, the United States Bureau of Mines is engaged in research work looking toward the utilization of the vast deposits of low-grade iron ores in Minnesota, Alabama, and elsewhere in the country. In this connection, the Bureau is operating, at its Minneapolis station, the only experimental blast furnace in the world capable of producing conditions encountered in large commercial furnaces.

In 1926, Canada added 266,000 H.P. to her block of hydro-electric energy, bringing the total up to 4,556,000 H.P. Other projects now in course of development will increase this by 1,700,000 H.P.